Province of British Columbia

Northwest Economic Development Studies

Transportation Options

Ministry of Industry and Small Business Development
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TRANSPORTATION OPTIONS

TASK FORCE ON NORTHWEST ECONOMIC DEVELOPMENT OPPORTUNITIES

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PREFACE

During late 1981 and early 1982 the Cabinet Committee on Economic Development made a series of fact-finding visits to Northwest British Columbia. In response to briefs presented by a large number of private citizens, corporations and public groups, the Cabinet Committee commissioned a report which would summarize the area's economic potential. That report "The Northwest Region, A British Columbia Regional Economic Study" was released on September 15, 1982.

The September 1982 report states that the area north of the Highway 16/CNR northline corridor has substantial development potential based mainly upon the significant but largely undeveloped mineral resources. However, this area lacks virtually all of the necessary infrastructure to sustain early large scale development. Lack of transportation and municipal facilities and adequate power at reasonable cost are seen as significant constraints to development at the present time. The report noted that development of minerals and other resources will require substantial private and public investments - investments which can only be made after careful planning and consideration of alternatives.

In response to the September 1982 report, the Cabinet Committee on Economic Development directed an Inter-Ministry Task Force to begin work on a series of detailed studies on the northern part of the Northwest region (i.e. from Stewart to the Yukon border). These studies were undertaken to determine the scale and timing of potential mineral developments, and to identify options to supply power, transportation and community infrastructure in order to serve those developments. The Task Force was also asked to identify the social and environmental issues which might arise as development proceeds.

The product of these studies is a set of six Inter-Ministry Task Force reports plus a summary report which includes the findings of these six background studies. It should be emphasized that these studies do not represent a blueprint for development, but rather indicate priorities for future planning and development. The reports identify options and, as far as possible, the negative and positive factors associated with each option. Final decisions on any specific development options would be premature at this stage. Such decisions will have to await further analysis and more concrete private sector proposals for the development of the resources of the region.

Finally, it should be noted that during the course of these studies the mine development scenarios were refined as more information became available. These scenarios have been updated in the background reports where possible. However, in the power supply report and the transportation report, the analysis is based on the original hypothetical development scenario. The environmental overview report is based upon the early definitions of potential development options provided by the other working groups. The conclusions of these reports are not materially altered by the refined development scenario.

NORTHWEST B.C. TRANSPORTATION STUDY

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Appendix 1: Transportation of Coal by Truck

1.0 BACKGROUND

In the initial discussions on Northwest Development the lack of infrastructure and particularly road access was identified as a major constraint to development in the Northwest. This was confirmed in the preliminary report entitled "The Northwest Region - A British Columbia Regional Economic Study 1982". That report finds that:

> "Road access is another key constraint on mining in the (Northwest). Highway 37, the only major access route, is inadequate for large scale mineral traffic flows. Also, quite lengthy access routes from the Highway 37 artery would be required to virtually all of the major mine sites...Development of the Mt. Klappan coal field would present another transportation problem...(since) it is unlikely to prove economic to truck (coal) to port facilities. Development is probably dependent upon the availability of rail transport...New transportation infrastructure in the zone and the subsequent mine development will result in a major outflow of products for export, thereby creating a need for expanded port facilities. The geographic location of most of the mineral deposits in the area will likely create a demand for additional services at Stewart... The product flows could be directed through Prince Rupert if this proved to be more economic."

Given the transportation constraints, the purpose of this section is to examine alternatives available in the northwest. A number of transportation options are discussed and each is tested on a mine by mine basis to determine optimum routings and modes for each mine. Once alternatives are identified recommendations on the most cost effective method to eliminate these constraints will be made.

2.0 PRODUCTION SCENARIOS

In order to examine the transportation requirements of new and existing mines in the area a set of assumptions with respect to production start up and timing was necessary.

The assumptions used in this regard are consistent with the production scenario developed by the Mineral Resource Working Group. This scenario represents a middle range forecast of price trends.

The proposed development scenario is shown below:

Existing Mines	Output (Tonnes Per Year)	Production Start	Expected Life
Cassiar	110,000 (tonnes of fibre)	-	1995
Granduc	15,000 (tonnes of concentrate	-	1998
Potential Mines			
Kutcho Creek (Cu, Zn)	120,000	1987	11 years
Adanac (Mo)	4,500	1989	31 years
Letain (Asb)	50,000	1990	15 years
Red Chris (Cu)	37,000	1990	20 years
Mt. Klappan (coal)	5,000,000	1990	20 years
Schaft Creek (Cu)	500,000	1992	25 years
Eaglehead (Cu)	50,000	1995	15 years
Sustut (Cu)	100,000	1996	8 years
Stikine (Cu)	350,000	2000	20 years

NOTE:

Later analyses conducted by the Mineral Analysis Working Group indicate that annual output tonnages of all mines except Mount Klappan would differ from the above. In most cases, annual tonnages are expected to be lower. Kutcho Creek's output, however, is expected to increase to 138,000 tonnes of concentrate per year. These output changes are not expected to change the essence of conclusions in Section 7.

For shipments of products it was assumed that in all cases a two year build up to the stated output was required. For instance, Kutcho Creek would ship 60,000 tonnes of concentrate in 1987 and in 1988 reach full production at 120,000 tonnes shipped. The expected life is taken from the start of production.

Furthermore, it is assumed that construction of the mines will take two years and that road construction will proceed this by one year in order to allow access to the mines during construction.

Using these assumptions the present value of the construction cost of the transportation infrastructure and operating costs have been calculated for a number of transportation options which were selected to cover full range of routes and technology that could be used to support development. These options are discussed in the next section.

3.0 TRANSPORTATION ALTERNATIVES

This section briefly describes the existing road and rail networks in Northwest B.C., and potential alternatives for the extension of these networks.

3.1 Existing Network

3.1.1 Road

At present the public road network in Northwest B.C. consists of: Highway 37 which extends 746 kilometres north from Kitwanga on Highway 16 to the Alaska Highway; the 67 kilometre Highway 37a connecting Stewart to Highway 37 at Meziadin junction; the Telegraph Creek-Dease Lake road (113 km) and the Cassiar-Highway 37 road (15 km). These highways are considered to be good all weather roads, mostly gravel but with sections of paving. There are, however, weight restrictions on the roads during spring break up.

In addition to public roads and highways, there are a number of roads in the region that have been built and operated by private companies such as B.C. Timber. The route from Terrace to the Nass River, connecting with Greenville and Highway 37, is a primary gravel road which is open to restricted use by the public. Certain sections of this route are established as public road and/or are maintained by the Province. A new gravel road is now being constructed by Amax, to provide road access to their townsite and mine at Kitsault.

Three public highways extend through British Columbia at the north end of the Alaska Panhandle (Jakes Corner, Yukon to Atlin, B.C.; Carcross, Yukon to Skagway, Alaska; Haines Junction, Yukon to Haines, Alaska). The Britsh Columbia sections of these routes total 200 km in length, of which 97 percent is gravel and 3 percent is sealed surface. Two of the highways serve to link Alaska communities to the Alaska highway system and the third links the main B.C. community in the area, Atlin, to Whitehorse and the Alaska highway system.

3.1.2 Rail

The present rail network in Northwest B.C. consists of the CNR northline, the CNR line to Kitimat and the BCR Dease Lake Extension. A schematic of the existing rail network in shown in Figure 3.1.

CNR Northline

This line runs east-west from Red Pass Junction, west of Jasper on the main CNR trans-continental line, to Prince Rupert via Prince George. The distance from Red Pass Junction to Prince Rupert is 1,089 km (677 miles). The line between Prince George and Prince Rupert is being upgraded at a probable cost of $150 million to handle coal and grain shipments, scheduled to move through the port at Ridley Island beginning in 1984. Further improvements will be required to handle the traffic to 1990. The 62 km branchline from Terrace to Kitimat, which was completed in 1954, is now operating with speed and load restrictions.

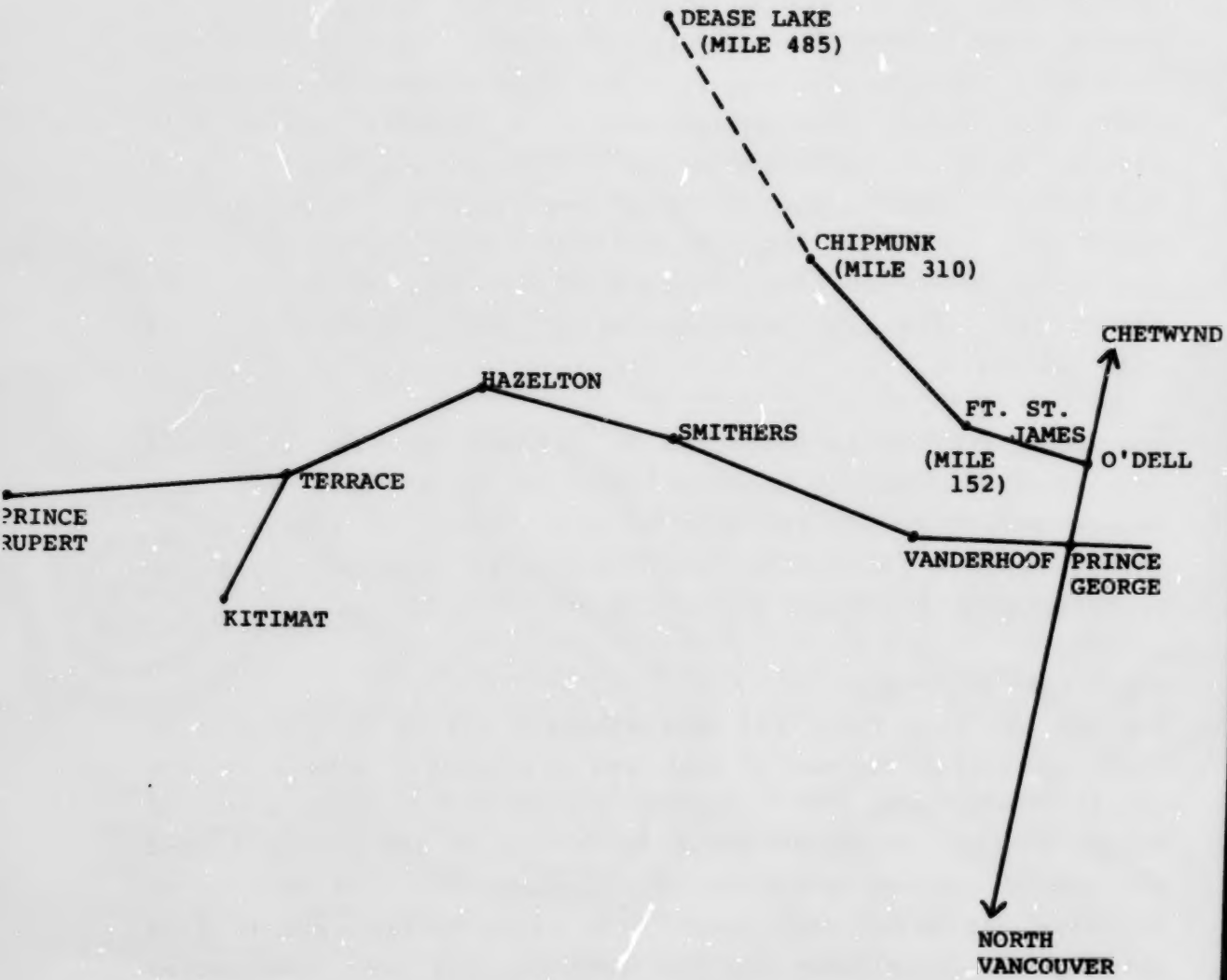
The CNR northline is connected to the BCR mainline at Prince George, thus enabling traffic from the Dease Lake and Fort Nelson Extensions of the BCR to gain access to tidewater at Prince Rupert. In future years Northeast Coal will also be transferred from the BCR to the CNR at Prince George.

Dease Lake Extension

The BCR has laid track for approximately 354 km (220 miles) of this extension, between O'Dell and Driftwood. O'Dell is the junction with the BCR mainline, 53 km (33 miles) north of Prince George. Track is built about 150 km (90 miles) beyond the end of current operation to Chipmunk, but this section of the line has never been used. The right-of-way extends from Chipmunk to Dease Lake and the subgrade has been constructed over much of this northerly section.

FIGURE 3.1

EXISTING RAIL NETWORK, NORTHWEST B.C.



Additional description of the existing road and rail networks is provided in the report "The Northwest Region, A British Columbia Regional Economic Study, 1982", prepared by the Interministry Working Group of Northwest British Columbia.

3.2 Base Case

Transportation alternatives considered in the base case are:-

i) Minerals from Kutcho, Letain, Red Chris, Schaft Creek, Eaglehead, Sustut and Stikine would be hauled by road, to either the port of Stewart or the port of Prince Rupert for export, whichever is the least cost haul.

ii) Minerals from Adanac would be taken by road or road and rail to Skagway, for export, and thus would not impact on the Highway 37 corridor.

iii) Coal from Klappan would be hauled by rail to the port of Prince Rupert for export.

3.2.1 Road

A schematic diagram of the potential road network in Northwest B.C. is shown in Figure 3.2. Table 3.1 provides a description of this network in terms of nodes, links and distances.

To provide road access to Highway 37 and thus a reasonably direct route to the ports of Stewart and Prince Rupert for the developing mines, several mine access roads will be necessary. To serve Kutcho Creek, Letain and Eaglehead it is expected that one road from Dease Lake into the Kutcho Creek area will be constructed. Short mine access routes will connect each mine to this main road. Such a road would also service any potential new community in the area and thus it is expected that this road would have a highway standard, gravel surface.

FIGURE 3.2

POTENTIAL ROAD LINK NETWORK
NORTHWEST B.C.

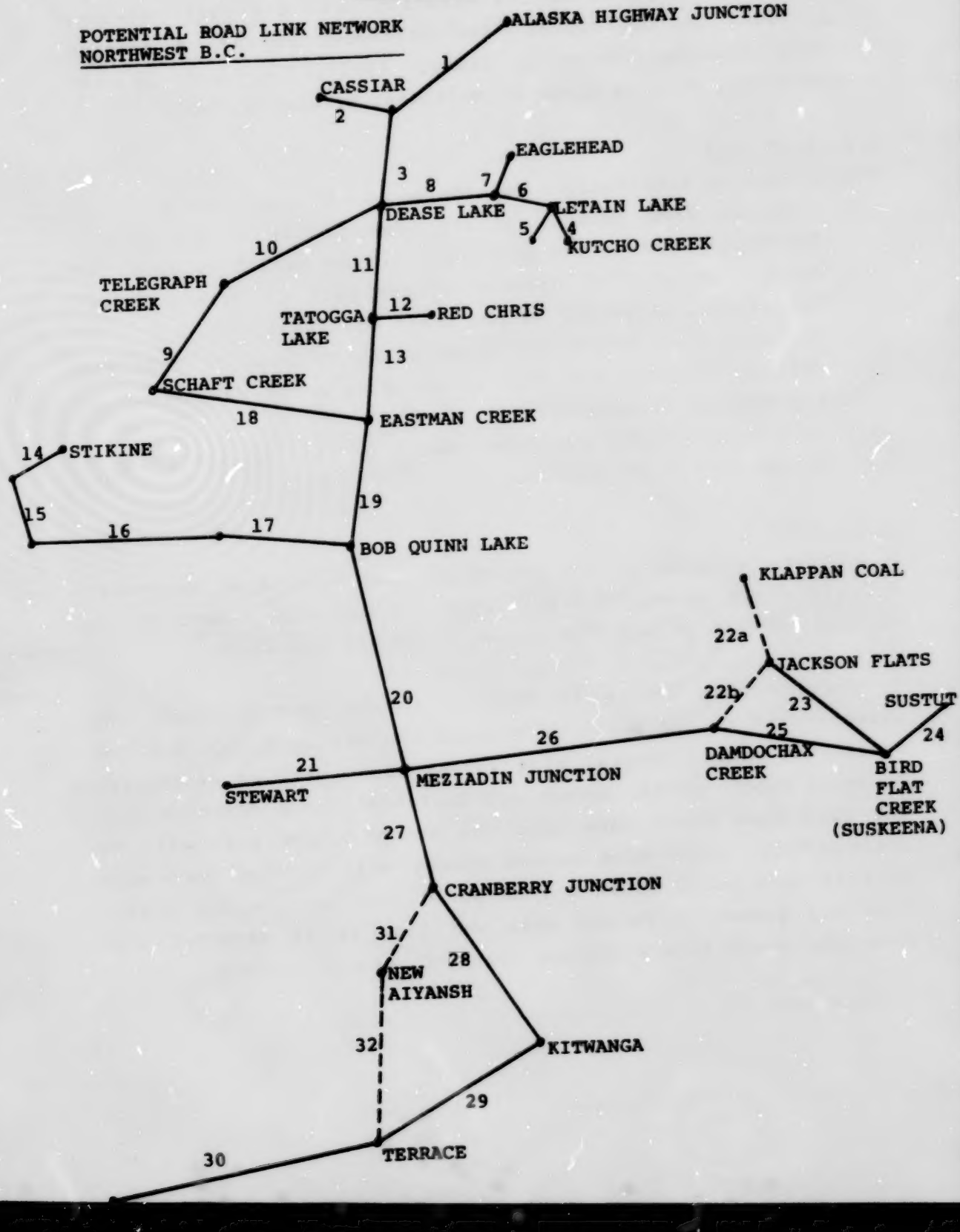


TABLE 3.1

Route Options Within Northwest Road Network

To Stewart

From (Mine)	Links in Route	Total Route Distance (km)
Kutcho	4,6,8,11,13,19,20,21	585
Letain	5,6,8,11,13,19,20,21	550
Eaglehead	7,8,11,13,19,20,21	545
Red Chris	12,13,19,20,21	400
Schaft Creek	18,19,20,21	328
Schaft Creek	9,10,11,13,19,20,21	656
Sustut	24,25,26,21	305
Stikine	14,15,16,17,20,21	394

To Prince Rupert

From (Mine)	Links in Route	Total Route Distance (km)
Kutcho	4,6,8,11,13,19,20,27,28,29,30	935
Letain	5,6,8,11,13,19,20,27,28,29,30	900
Eaglehead	7,8,11,13,19,20,27,28	895
Red Chris	12,13,19,20,27,28,29,30	750
Schaft Creek	18,19,20,27,28,29,30	678
Sustut	24,25,26,27,28,29,30	655
Stikine	14,15,16,17,20,27,28,29,30	744

To serve Schaft Creek, there appear to be two alternative routes from Highway 37. The first would be a circuitous route from Dease Lake via Telegraph Creek. Another could be from Eastman Creek on Highway 37 via Raspberry Pass through Mt. Edziza Park. A third route, from Bob Quinn via More Creek, has not been considered because the route would likely be flooded by the proposed hydro dam on More Creek. It is expected that the route selected would link a townsite (Kinaskan) to the mine and the standard of construction would likely be that for a highway with gravel surface.

The Stikine (Galore Creek) mine is in a very isolated location, with difficult access problems. A consultant's report[1] indicates that two terminal locations for the outgoing shipment of concentrate and the incoming landing of supplies have been considered namely Stewart and a future designated location at the mouth of the Stikine River near Wrangell, Alaska. Four modes have been considered for the transportation of concentrate (i.e. trucks, river barges, hovercraft, concentrate pipeline); three modes for supplies (trucks, barges, hovercraft) and buses for personnel.

As far as is known no decisions have been taken by the developers upon the preferred transportation alternative. For the purpose of this study a road link to Highway 37 has been considered as the preferred alternative for the following reasons:

i) This would enable concentrate to be hauled to either Stewart or Prince Rupert where there are existing terminal facilities and which are expected to serve the future development needs of Northwest B.C.

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1 Wright Engineers Limited, "Review of Access Alternatives, Stikine Copper Project", prepared for Hudson Bay Mining and Smelting Co. Ltd., August 1981.

ii) Shipment of concentrate by barge on the Stikine River would be a seasonal arrangement because of fluctuating water levels and difficult navigation.

iii) Shipment of concentrate by hovercraft on the Stikine River would involve a technology about which little is known in regard to handling heavy, bulk freight and therefore difficult to incorporate in this prefeasibility study analysis.

iv) The establishment of a terminal facility in Alaska would involve international negotiations and agreements, the outcomes of which are difficult to predict at this time.

Since the Red Chris property is adjacent to Highway 37, only a short access route is necessary for that property.

The Sustut property, on the other hand, may require a new, 238 km. access road to Highway 37, if concentrate is to be hauled to Stewart and/or Prince Rupert. The route of this road is assumed to be from Sustut via the Sustut, Skeena and Nass River valleys to Meziadin Junction. Another alternative for concentrate haul may be a route via an extended Omineca road to Fort St. James. However, this alternative would involve a longer and more costly haul to tidewater and has not been further considered in this stage of the study.

Finally, to provide access to the Mount Klappan property for employees, a road would likely be required. This access route would likely be via links 22a, 22b and 26 as shown in Figure 3.2.

Thus, within this road network the mines-to-port route options are limited since, with the exception of Adanac, Mount Klappan and Sustut, the Highway 37 corridor is common to all mines. It can be noted from Figure 3.2 that there are two options to

Prince Rupert but the distance via links 28 and 29 is virtually the same as via links 31 and 32. However, the capital cost of the route via New Aiyansh is substantially greater than the capital cost and the added operating cost of taking the slightly longer route via Kitwanga. Thus the New Aiyansh route has not been considered for further analysis.

3.2.2 Rail

The base case assumes coal would be transported from Klappan to Prince Rupert by one of four alternative rail routes. These route alternatives are shown schematically in Figure 3.3. Completion of the BCR Dease Lake Extension to Klappan would be necessary as well as some upgrading of existing track on the Extension; the amount depending on the alternative selected.

The first alternative would make maximum use of existing track on the Extension. Unit coal trains would travel from Klappan to Prince George on the BCR then switch to CNR Northline for the remainder of the journey to Prince Rupert.

The second alternative considers construction of a short connector between Fort St. James on the BCR and Vanderhoof on the CNR.

The third alternative would be to utilize the grade of the BCR from Klappan to Suskeena (junction of the Sustut and Skeena Rivers); then construct new grade along the Skeena River to connect with the CNR at Hazelton.

The fourth alternative would be to utilize the grade of the BCR from Klappan to Jackson Flats; then construct new grade south along Slowmaldo Creek and Damdochax Creek to the Nass River; west along the Nass River to Meziadin; south along Highway 37 to Cranberry Junction, west to New Aiyansh; south to a connection with the CNR at Terrace.

Table 3.2 following provides descriptions of these alternative railway networks in terms of links, status and distance.

FIGURE 3.3

ALTERNATIVE RAILWAY NETWORKS, NORTHWEST B.C.

BASE CASE

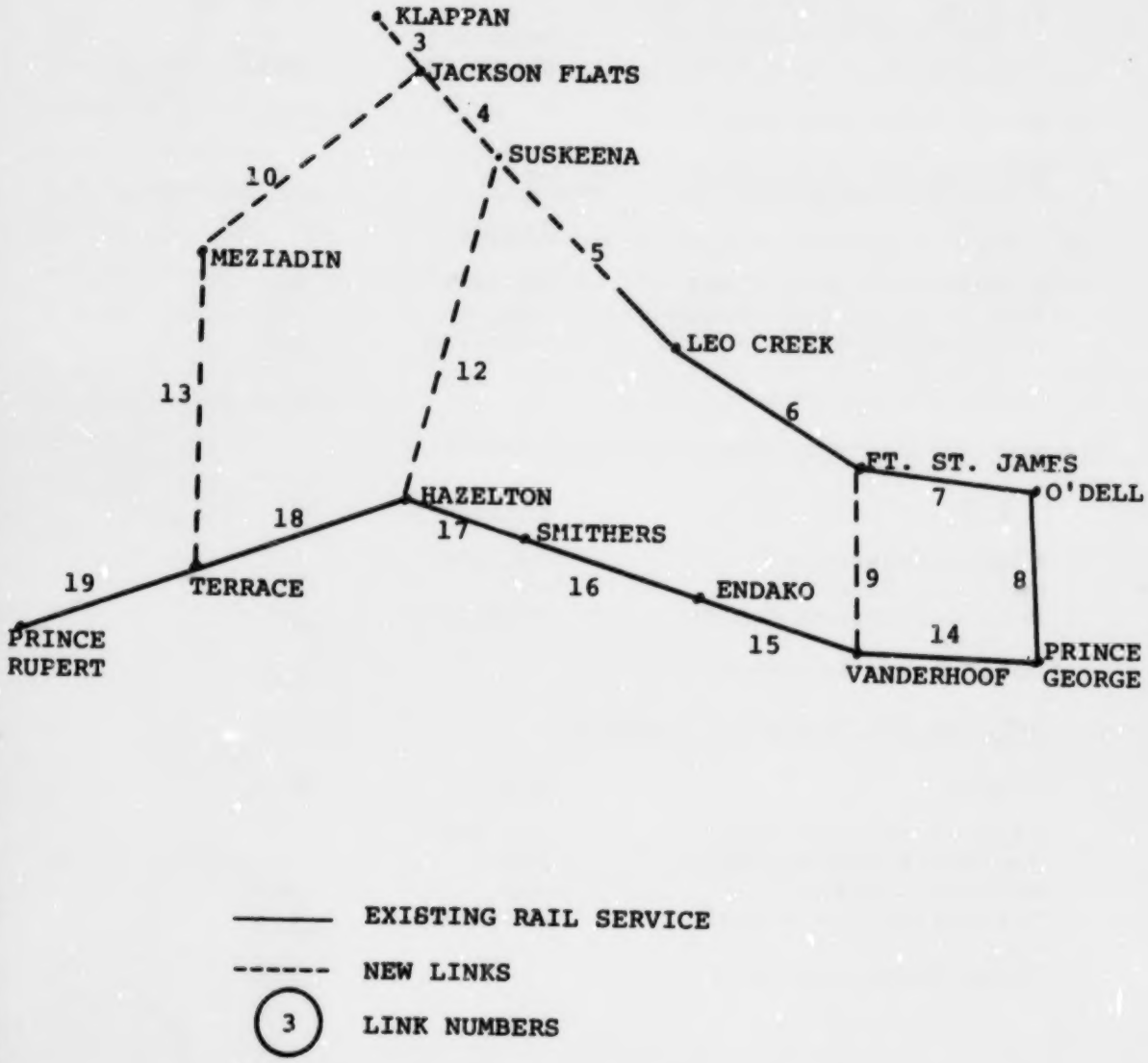


TABLE 3.2

Alternative Railway Networks, Northwest B.C.
Case 1 - Base Case

1. BCR/CNR Via Prince George

Link	Status	km
Klappan-Fort St. James	upgrade	476
Fort St. James-Prince George	upgrade	170
Prince George-Vanderhoof	existing	124
Vanderhoof-Prince Rupert	existing	628
Total Route Distance		1398

2. BCR/CNR Via Vanderhoof Connector

Link	Status	km
Klappan-Fort St. James	upgrade	476
Fort St. James-Vanderhoof	new	61
Vanderhoof-Prince Rupert	existing	628
Total Route Distance		1165

3. BCR/CNR Via Hazelton Connector

Link	Status	km
Klappan-Suskeena	upgrade	145
Suskeena-Hazelton	new	195
Hazelton-Prince Rupert	existing	291
Total Route Distance		631

4. BCR/CNR Via Meziadin Connector

Link	Status	km
Klappan-Jackson Flats	upgrade	71
Jackson Flats-Meziadin	new	161
Meziadin-Terrace	new	209
Terrace-Prince Rupert	existing	153
Total Route Distance		594

3.3 Case 2: BCR extension from Klappan to Dease Lake

This case considers an extension of the BCR from Klappan to Dease Lake, a distance of 190 km (118 miles). Klappan coal would continue to be transported over the BCR and CNR to Prince Rupert via the least cost route. However, this extension would also provide a rail option for the transportation of concentrates from five potential mines in the region (Kutcho, Letain, Eaglehead, Red Chris and Sustut) to Prince Rupert.

The extension would not directly serve the mines, except for Klappan coal. Road haulage of concentrates would be required from the mines to a railhead. Concentrates from Kutcho, Letain and Eaglehead would be hauled to a road-rail transfer facility at Dease Lake; Red Chris concentrate to a transfer facility at McEwan Creek, approximately 50 km by road from the mine, and Sustut concentrate to a transfer facility at Suskeena.

A schematic diagram of the rail is shown in Figure 3.4 and a description in terms of nodes and distances is shown in Tables 3.3 and 3.4.

FIGURE 3.4

ALTERNATIVE RAILWAY NETWORKS, N.W.B.C.

CASE NO. 2

EXTENSION OF BCR FROM KLAPPAN TO DEASE LAKE

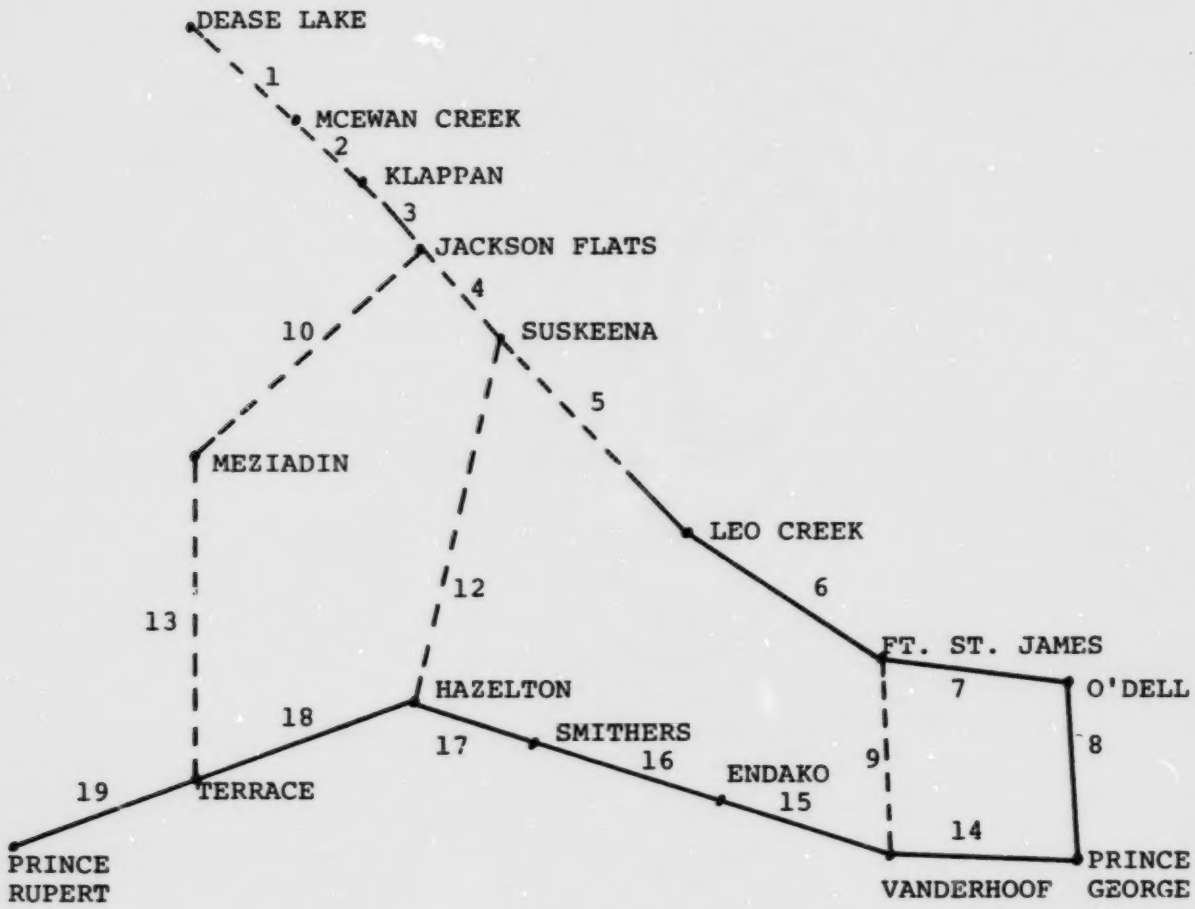


Table 3.3

Alternative Railway Networks, Northwest B.C.
Case 2 - Extension of BCR from Klappan to Dease Lake

1. BCR/CNR Via Prince George

Links	Status	km
Dease Lake-McEwan Creek	upgrade	90
McEwan Creek-Klappan	upgrade	100
Klappan-Suskeena	upgrade	145
Suskeena-Fort St. James	upgrade	331
Fort St. James-Prince George	upgrade	170
Prince George-Vanderhoof	existing	124
Vanderhoof-Prince Rupert	existing	628
Total Route Distance		1588

2. BCR/CNR Via Vanderhoof Connector

Links	Status	km
Dease Lake-McEwan Creek	upgrade	90
McEwan Creek-Klappan	upgrade	100
Klappan-Suskeena	upgrade	145
Suskeena-Fort St. James	upgrade	331
Fort St. James-Vanderhoof	new	61
Vanderhoof-Prince Rupert	existing	628
Total Route Distance		1355

3. BCR/CNR Via Hazelton Connector

Link	Status	km
Dease Lake-McEwan Creek	upgrade	90
McEwan Creek-Klappan	upgrade	100
Klappan-Suskeena	upgrade	145
Suskeena-Hazelton	new	195
Hazelton-Prince Rupert	existing	291
Total Route Distance		821

4. BCR/CNR Via Meziadin and Terrace

Link	Status	km
Dease Lake-McEwan Creek	upgrade	90
McEwan Creek-Klappan	upgrade	100
Klappan-Jackson Flats	upgrade	71
Jackson Flats-Meziadin	new	161
Meziadin-Terrace	new	209
Terrace-Prince Rupert	existing	153
Total Route Distance		784

TABLE 3.4

TOTAL DISTANCE FROM EACH MINE TO PRINCE RUPERT
ALL MODES OF TRANSPORT

TO PRINCE RUPERT FROM	ROAD HAUL	RAIL HAUL				TOTAL DISTANCE			
		VIA PRINCE GEORGE	VIA VANDERHOOF CONNECTOR	VIA HAZELTON CONNECTOR	VIA MEZIADIN CONNECTOR	VIA PRINCE GEORGE	VIA VANDERHOOF CONNECTOR	VIA HAZELTON CONNECTOR	VIA MEZIADIN CONNECTOR
	km	km	km	km	km	km	km	km	km
Kutcho	110	1588	1355	821	784	1698	1465	931	894
Letain	75	1588	1355	821	784	1663	1430	896	859
Eaglehead	70	1588	1355	821	784	1658	1425	891	854
Red Chris	50	1498	1265	731	694	1548	1315	781	744
Klappan	NIL	1398	1165	631	594	1398	1165	631	594
Sustut*	45(119)	1253	1020	486	(523)	1298	1065	531	(642)

Sustut*

- 45 - Assumes road haulage from Sustut to a railhead at Suskeena.
- (119 - Assumes road haulage from Sustut to a railhead at Jackson Flats.)

3.4 Case 3: Construction of a Rail Line from Dease Lake to Stewart

This case considers the construction of a new rail route from Dease Lake and Klappan to Stewart via Meziadin. This would provide an alternative to the road options of Case 1 and the previously described rail alternatives.

The northern railhead would be Dease Lake and the line would utilize the grade of the BCR to Jackson Flats; then new grade south along Slowmaldo Creek and Damdochax Creek to the Nass River; west along the Nass River to Meziadin; and over Bear Pass to Stewart.

Relative to the previous cases, this railway would reduce the haul distance for Klappan coal to a tidewater port and provide a rail option for the transportation of concentrates from five potential mines in the region to Stewart.

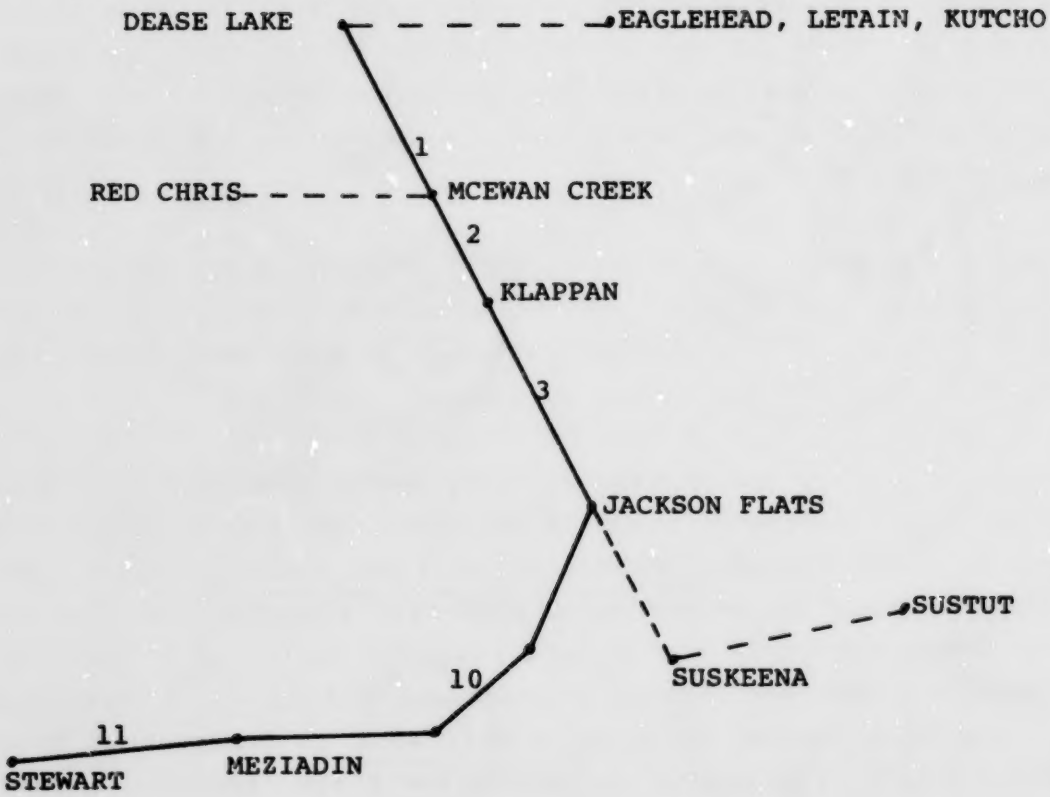
Since the railway would only directly serve Klappan coal, road haulage of concentrates would be required from the mines to the railway. For example, concentrates from Kutcho, Letain and Eaglehead would be hauled to a road-rail transfer facility at Dease Lake; Red Chris concentrate would be hauled to a facility at McEwan Creek and Sustut concentrate either to a transfer facility at Suskeena (assuming a rail spur is constructed from Jackson Flats to Suskeena) or to Jackson Flats (assuming a road is constructed on the BCR grade between Suskeena and Jackson Flats).

A schematic diagram of the rail and associated road network is shown in Figure 3.5 and a description in terms of nodes and distances is shown in Table 3.5.

FIGURE 3.5

ALTERNATIVE RAILWAY NETWORK, NORTHWEST B.C.

CASE NO. 3 - RAIL LINE
FROM DEASE LAKE TO STEWART



——— LINK NUMBERS

------ MINE ACCESS ROADS TO RAILHEADS

TABLE 3.5

Alternative Railway Network, Northwest B.C.
Case 3 - Rail Line from Dease Lake to Stewart

Railway Link	km
Dease Lake-McEwan Creek	90
McEwan Creek-Klappan	100
Klappan-Jackson Flats	71
Jackson Flats-Meziadin	161
Meziadin-Stewart	71
TOTAL	493

TOTAL DISTANCE FROM EACH MINE TO STEWART, ALL MODES OF TRANSPORT

TO STEWART FROM:	ROAD HAUL KM	RAIL HAUL KM	TOTAL KM
Kutcho	110	493	603
Letain	75	493	568
Eaglehead	70	493	563
Red Chris	50	403	554
Klappan	NIL	303	303
Sustut	119*	232	351

* - To Jackson Flats

3.5 Case 4: Construction of a Coal Slurry Pipeline from Klappan to Stewart

This case considers the construction of a coal slurry pipeline from Klappan coal via the route for the railway considered in Case 5 (ie. Klappan, Jackson Flats, Slowmaldo Creek, Damdochax Creek, Nass River and over Bear Pass). It is assumed that concentrates would be hauled by road to either Stewart or Prince Rupert, as per Case 1 the base case.

4.0 CASE NO. 1, BASE CASE

The transportation alternatives considered in the base case are: 1) concentrates from seven new mines are hauled by road to either Stewart or Prince Rupert, for export, 2) coal from Klappan is hauled by rail to Prince Rupert, for export.

4.1 Concentrate Transportation by Road

4.1.1 Network

The existing and potential road networks for hauling concentrates have been described in Sections 3.1.1 and 3.2.1 and are summarized in Figure 3.2 and Table 3.1.

4.1.2 Traffic & Vehicle Movements

Highway 37 traffic estimates were prepared for the Ministry of Transportation and Highways by Canadian Resourcecon Limited in 1975. The consultant's 1974 estimates and 1980 projections, shown in Table 4.1, are intended to be 'order of magnitude' numbers only. Tourism traffic was assumed to grow at 7% annually between 1974 and 1980.

Highways conducted traffic surveys along Highway 37 in the summer of 1980, with the following results. (See Table 4.2.) Comparing Tables 4.1 and 4.2 indicates that the daily average vehicle traffic on the route did not increase as quickly as was anticipated by the consultant, except in the proximity of Kitwanga and Dease Lake. At this time, there are no equivalent estimates for traffic growth in the 1982-2000 period.

TABLE 4.1

TRAFFIC ESTIMATES: KITWANGA-MEZIADIN HIGHWAY

SOURCE OF TRAFFIC	1974 TOTAL VEHICLE TRAFFIC*			1980 TOTAL VEHICLE TRAFFIC*		
	Annually	Daily Average July	Daily Average January	Annually	Daily Average July	Daily Average January
Through Traffic to Yukon and Alaska[1]	-	-	-	42,000 (67,000)	420 (670)	30 (40)
Tourism/Recreational Traffic						
- non-resident[2]	5,000	50	-	10,000	100	-
- resident[3]	8,000	80	-	12,000	120	-
Local Traffic[4]	20,800	60	60	26,000	71	71
Commercial Traffic						
- through to Yukon/Alaska[5]	-	-	-	10,000	67	17
- logging trucks[6]	12,960	35	35	12,960	35	35
- local[7]	4,800	13	13	7,200	20	20
TOTAL	51,560	238	108	120,160(145,160)	833(1,083)	173(183)

* counting both northbound and southbound vehicles

SOURCE: Resourcecon

NOTES:

(1) Approximately 90,000 visitors to the Yukon and Alaska travelled the Alaska Highway in 1974. Estimated to increase 135,000 in 1980; at 3.2 persons/vehicle this implies approximately 42,000 vehicle trips to the Yukon. Estimate is that at least 50% and perhaps as much as 80% of the traffic will use the Kitwanga Route (bracketed figure). July accounts for 30% of the traffic.

(2) Non-resident is defined as resident outside the Highway 16 region. Approximately 2,500 party visits to Stewart/Cassiar in 1974 estimated by Fisheries and Marine Service (see Sources), estimated to double by 1980. July accounts for 30% of the annual traffic.

(3) Resident is defined as resident of the Highway 16 region. Approximately 4,000 party visits to Stewart/ Cassiar in 1974 estimated by Fisheries and Marine Service (see Sources), estimated to increase 50% by 1980. July accounts for 30% of the annual traffic.

(4) Estimated at approximately 200 per week in 1974 - 150 from the logging camps, 50 from Stewart. Increased by 25% in 1980.

(5) Through trucks estimated at 5,000 vehicles/yr. using the Kitwanga route. July accounts for 20% of the annual traffic.

(6) An average of 27 load of logs per day from Cranberry Junction to Kitwanga - 240 day per year.

(7) Local commercial vehicles estimated at 4,800 vehicles in 1974; increase of 50% to 7,200 vehicles by 1980 - 240 days per year.

(8) The daily average is calculated by determining the total traffic volume for the month and dividing the number of days in the month. The traffic pattern normally varies on a weekly basis, e.g. the Department of Highways finds that Thursday traffic volumes tend to approximate the daily average (for the month) with higher volume than the daily average at the weekend and lower volume at the beginning of the week.

TABLE 4.2

Highway 37, Traffic Surveys, Summer 1980

Location	Total Vehicles/Day
Skeena River Bridge, Kitwanga	800-1500 (ave. 1200)
Nass River Junction (South of Cranberry Junction)	450-500
Other locations enroute Dease Lake	450-500
Dease Lake (Hwy 37 and Junction of of Telegraph Creek Road)	500-700
Cassiar Junction (12 km south of junction)	500
Cassiar Road	700
North of Cassiar Junction	500

SOURCE: Ministry of Transportation and Highways

The opening of new mines in Northwest B.C. would generate a significant increase in traffic on Highway 37. To establish the outbound traffic volumes, the concentrate outputs and timing as shown in production Scenario I were utilized. Output from the existing Cassiar mine was also considered. In each case it was assumed that the entire annual production was trucked to Stewart or Prince Rupert in 35 tonne carrying capacity trucks.

Each mine generates traffic over each link in the network and the effect is cumulative as more mines come on stream. These volumes can then be translated to daily vehicle movements on the basis of 35 tonne trucks and a 250 day work year.

Table 4.3 for example indicates the outbound volumes of concentrate moving to the Port of Stewart, assuming traffic from Schaft Creek uses the Raspberry Pass route (i.e. link 18 in Figure 3.1) to enter Highway 37 at Eastman Creek. The table illustrates how traffic would feed into the Highway 37 network on a link-by-link basis, and how traffic demand on each link fluctuates, year-by-year, according to the projected outputs from mines in the region. The heaviest volume of traffic, in this case, would be carried on link 21 (Meziadin to Stewart) since this link constitutes the only road access to the Port of Stewart.

Table 4.4 shows the conversion of the above traffic volumes into daily, return trips by heavy vehicles. For example, it is projected there will be about 100 trips, each way, each day on link 21 in 1997 and 1998. By comparison the haulage of asbestos from Cassiar to Stewart may have generated five round trips per day, on average, in 1982.

To determine total vehicle movements an estimate of inbound goods during operations is also necessary. This is estimated from Table 4.5 following.

table 4.3 in 000's of tonnes

year	road link numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1985 :	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
1986 :	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
1987 :	0.0	50.0	50.0	60.0	0.0	60.0	0.0	60.0	0.0	0.0	110.0	0.0	110.0	0.0	0.0
1988 :	0.0	50.0	50.0	120.0	0.0	120.0	0.0	120.0	0.0	0.0	170.0	0.0	170.0	0.0	0.0
1989 :	0.0	50.0	50.0	120.0	0.0	120.0	0.0	120.0	0.0	0.0	170.0	0.0	170.0	0.0	0.0
1990 :	0.0	50.0	50.0	120.0	25.0	145.0	0.0	145.0	0.0	0.0	195.0	18.5	213.5	0.0	0.0
1991 :	0.0	50.0	50.0	120.0	50.0	170.0	0.0	170.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1992 :	0.0	50.0	50.0	120.0	50.0	170.0	0.0	170.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1993 :	0.0	50.0	50.0	120.0	50.0	170.0	0.0	170.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1994 :	0.0	50.0	50.0	120.0	50.0	170.0	0.0	170.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1995 :	0.0	50.0	50.0	120.0	50.0	170.0	25.0	195.0	0.0	0.0	245.0	37.0	282.0	0.0	0.0
1996 :	0.0	0.0	0.0	120.0	50.0	170.0	50.0	220.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1997 :	0.0	0.0	0.0	120.0	50.0	170.0	50.0	220.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1998 :	0.0	0.0	0.0	120.0	50.0	170.0	50.0	220.0	0.0	0.0	220.0	37.0	257.0	0.0	0.0
1999 :	0.0	0.0	0.0	0.0	50.0	50.0	50.0	100.0	0.0	0.0	100.0	37.0	137.0	0.0	0.0
2000 :	0.0	0.0	0.0	0.0	50.0	50.0	50.0	100.0	0.0	0.0	100.0	37.0	137.0	175.0	175.0

year	road link numbers 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1985 :	0.0	0.0	0.0	50.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986 :	0.0	0.0	0.0	50.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987 :	0.0	0.0	0.0	110.0	110.0	110.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988 :	0.0	0.0	0.0	170.0	170.0	170.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989 :	0.0	0.0	0.0	170.0	170.0	170.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990 :	0.0	0.0	0.0	213.5	213.5	213.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991 :	0.0	0.0	0.0	257.0	257.0	257.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992 :	0.0	0.0	250.0	507.0	507.0	507.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993 :	0.0	0.0	500.0	757.0	757.0	757.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994 :	0.0	0.0	500.0	757.0	757.0	757.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995 :	0.0	0.0	500.0	782.0	782.0	782.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996 :	0.0	0.0	500.0	757.0	757.0	807.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997 :	0.0	0.0	500.0	757.0	757.0	857.0	0.0	0.0	50.0	50.0	50.0	0.0	0.0	0.0	0.0
1998 :	0.0	0.0	500.0	757.0	757.0	857.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0	0.0	0.0
1999 :	0.0	0.0	500.0	637.0	637.0	737.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0	0.0	0.0
2000 :	175.0	175.0	500.0	637.0	812.0	912.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0	0.0	0.0

vehicle laps per day:
35 tonnes per trip, 250 days per year, 2 trips per vehicle (return)
table 4.4

year	road link numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1985 :	0.0	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	11.4	0.0	0.0
1986 :	0.0	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	11.4	0.0	0.0
1987 :	0.0	11.4	11.4	13.7	0.0	13.7	0.0	13.7	0.0	0.0	25.1	0.0	25.1	0.0	0.0
1988 :	0.0	11.4	11.4	27.4	0.0	27.4	0.0	27.4	0.0	0.0	38.9	0.0	38.9	0.0	0.0
1989 :	0.0	11.4	11.4	27.4	0.0	27.4	0.0	27.4	0.0	0.0	38.9	0.0	38.9	0.0	0.0
1990 :	0.0	11.4	11.4	27.4	5.7	33.1	0.0	33.1	0.0	0.0	44.6	4.2	48.8	0.0	0.0
1991 :	0.0	11.4	11.4	27.4	11.4	38.9	0.0	38.9	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1992 :	0.0	11.4	11.4	27.4	11.4	38.9	0.0	38.9	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1993 :	0.0	11.4	11.4	27.4	11.4	38.9	0.0	38.9	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1994 :	0.0	11.4	11.4	27.4	11.4	38.9	0.0	38.9	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1995 :	0.0	11.4	11.4	27.4	11.4	38.9	5.7	44.6	0.0	0.0	56.0	8.5	64.5	0.0	0.0
1996 :	0.0	0.0	0.0	27.4	11.4	38.9	11.4	50.3	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1997 :	0.0	0.0	0.0	27.4	11.4	38.9	11.4	50.3	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1998 :	0.0	0.0	0.0	27.4	11.4	38.9	11.4	50.3	0.0	0.0	50.3	8.5	58.7	0.0	0.0
1999 :	0.0	0.0	0.0	0.0	11.4	11.4	11.4	22.9	0.0	0.0	22.9	8.5	31.3	0.0	0.0
2000 :	0.0	0.0	0.0	0.0	11.4	11.4	11.4	22.9	0.0	0.0	22.9	8.5	31.3	40.0	40.0

year	road link numbers 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1985 :	0.0	0.0	0.0	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986 :	0.0	0.0	0.0	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987 :	0.0	0.0	0.0	25.1	25.1	25.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988 :	0.0	0.0	0.0	38.9	38.9	38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989 :	0.0	0.0	0.0	38.9	38.9	38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990 :	0.0	0.0	0.0	48.8	48.8	48.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991 :	0.0	0.0	0.0	58.7	58.7	58.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992 :	0.0	0.0	57.1	115.9	115.9	115.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993 :	0.0	0.0	114.3	173.0	173.0	173.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994 :	0.0	0.0	114.3	173.0	173.0	173.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995 :	0.0	0.0	114.3	178.7	178.7	178.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996 :	0.0	0.0	114.3	173.0	173.0	184.5	0.0	0.0	11.4	11.4	11.4	0.0	0.0	0.0	0.0
1997 :	0.0	0.0	114.3	173.0	173.0	195.9	0.0	0.0	22.9	22.9	22.9	0.0	0.0	0.0	0.0
1998 :	0.0	0.0	114.3	173.0	173.0	195.9	0.0	0.0	22.9	22.9	22.9	0.0	0.0	0.0	0.0
1999 :	0.0	0.0	114.3	145.6	145.6	168.5	0.0	0.0	22.9	22.9	22.9	0.0	0.0	0.0	0.0
2000 :	40.0	40.0	114.3	145.6	185.6	208.5	0.0	0.0	22.9	22.9	22.9	0.0	0.0	0.0	0.0

TABLE 4.5

Inbound Mining Supplies Required Per Ton of Ore Milled[1]

Item	Weight in lbs. of Supplies Per Ton Milled
Mill Supplies	4.0 - 5.0
Explosives	1.5 - 2.5
Mine Supplies	.5
Food	.5
Sub Total	6.5 - 8.5
Fuel	
- open pit	1.5 - 6.0
- plant heating	3.0 - 5.0
- power generation	10.0 - 15.0
TOTAL	21.0 - 34.5

NOTE:

1. Hedlin Menzies and Associates Ltd., "The Canadian Northwest Transportation Study - Volume I: The Mineral Potential", October 1969, p. 139.

A mid-point was used and it was assumed for simplicity that hydro electric power would be available, thereby reducing the total requirements to about 7.6 kilograms imported for each tonne milled. Table 4.6 shows the total annual imports for each mine based on the above.

TABLE 4.6

Inbound Volumes By Mine

Mine	Ore Milled (tonnes)	Imports (tonnes)
Kutcho	1,505,000	11,500
Red Chris	1,050,000	8,000
Eaglehead	1,050,000	8,000
Schaft Creek	35,000,000	266,000
Sustut	2,100,000	16,000
Stikine	10,500,000	80,000

The asbestos mines are not included since it was assumed that requirements could be handled in the returning containers. For concentrates, however, inbound material will require additional truck movements.

It is assumed that inbound material can be hauled in 25 tonne lots in containers. The added vehicle movements are relatively minor adding about 1 to 2 vehicles per mine per day except in the case of Schaft Creek and Stikine which add about 30 and 10 vehicle movements per day respectively.

Finally, it should be noted that while the inbound volumes and vehicle movement counts are necessary inputs to determine construction requirements, the cost of these inbound shipments are assumed to be included in mine costs and do not form a part of the transport costs of mine outputs.

4.1.3 Road Construction Costs

Highway 37 has been significantly upgraded over the last decade to a good all weather standard. Nevertheless, it has a gravel surface for 74% of its length, and only 26% is paved. To bring the highway to a uniform standard, allow for increased traffic and eliminate spring load restrictions for heavy vehicles the highway would have to be widened or re-constructed; since adding gravel would tend to reduce the width of the driving surface and safety levels.

The traffic generated by new developments and the operation of the new mines in the region has been considered to set the level of service requirements on the road network and thus road design and maintenance standards. Other traffic associated with residential travel and tourism is assumed not to require alternative standards or to generate capacity constraints.

Two standards of road construction have been considered for the network to reflect varying levels and types of useage. In order to prepare cost estimates for the reconstruction of

Highway 37 and its principal branches (eg. to Stewart), the standard of a 10.36 metre, paved surface and an average speed of 80 km/h was considered. For public, all weather roads linking Highway 37 to the mines, an 8 metre, gravel surface and an average speed of 50 km/h was considered.

Typical costs for each standard are summarized in the table below.

TABLE 4.7

Typical Road Standards and Unit Costs, Northwest B.C.

1. Highways (80 km/h)

Standard	- 10.36 m (34') finished surface
Grade Construction	- $400,000/km (approx.)
Paving	- $100,000/km
Bridges	- $500,000 (approx.)

2. Mine Access Roads (50 km/h)

Standard	- 8 m finished road
Site preparation, sub-grade, gravelling, drainage and special structures	$200,000/km (approx.)

These unit costs were prepared from a sampling of cost data for the upgrading of Highway 37; also using data from two consultants' reports[1] dealing with mine access roads in the region.

The cost estimates pertinent to each link's upgrading or new construction were then applied to produce most of the road link cost estimates shown in Table 4.8. Exceptions to this generalized cost estimating process are listed in the subscripts to the table.

1. Wright Engineers Limited, "Review of Access Alternatives, Stikine Copper Project"; T.M. Thomson, "Cost Estimates for a Kutcho Creek Road".

TABLE 4.8

ROAD LINK COSTS (Mid 1982 $ MILLIONS)

Link	Description	Approximate Length (km)	Capital Cost Construction (Gravel)	Capital Cost Upgrade (Pavement)	Total Capital Cost
1	Hwy 37: Alaska Hwy Junction-Cassiar Intersect.	122	48.8	12.2	61.0
2	Cassiar - Hwy 37	15	15.0	1.5	16.5
3	Hwy 37: Cassiar Intersect-Dease Lake	114	26.8	6.7	33.5
4	Kutcho Creek-Letain Lake	40	8.0	-	8.0
5	Letain Mine-Letain Lake	5	1.0	-	1.0
6	Letain Lake-Turnagain River	15	3.0	-	3.0
7	Eaglehead-Turnagain River	15	3.0	-	3.0
8	Turnagain River-Dease Lake	55	11.0	-	11.0
9	Schaft Creek-Telegraph Creek	68	13.6	-	13.6
10	Telegraph Creek-Dease Lake	113	2.4	-	2.4
11	Hwy 37: Dease Lake-Tatogga Lake	82	32.8	8.2	41.0
12	Red Chris-Tatogga Lake	7	1.4	-	1.4
13	Hwy 37: Tatogga Lake-Eastman Creek	55	22.0	5.5	27.5
14	Galore Creek Mine (Stikine) - West Face of Jack Wilson Tunnel	16	60.0	-	60.0
15	Tunnel Face - Iskut River Crossing	54	54.0	-	54.0
16	Iskut River - B.C. Hydro Road	67	52.3	-	52.3
17	B.C. Hydro - Bob Quinn Lake	45	9.0	-	9.0
18	Schaft Creek - Eastman Creek Via Rasp Pass	60	12.0	-	12.0
19	Hwy 37: Eastman Creek-Bob Quinn Lake	55	22.0	5.5	27.5
20	Hwy 37: Bob Quinn Lake-Meziadin Junction	146	56.0	14.0	70.0

TABLE 4.8 (CONTINUED)

ROAD LINK COSTS ($ MILLIONS)

Link	Description	Approximate Length (km)	Capital Cost Construction (Gravel)	Capital Cost Upgrade (Pavement)	Total Capital Cost
21	Hwy 951: Meziadin Junction-Stewart	67	-	5.5	5.5
22(a)	Klappan Coal-Jackson Flats	55	11.0	-	11.0
22(b)	Jackson Flats - Damdochax Creek	45	9.0	-	9.0
23	Jackson Flats - Suskeena	74	14.8	-	14.8
24	Sustut-Birdflat Creek (Suskeena)	45	9.0	-	9.0
25	Birdflat Creek-Damdochax Creek	98	19.6	-	19.6
26	Damdochax Creek-Meziadin Junction	95	19.0	-	19.0
27	Hwy 37: Meziadin Junction-Cranberry Junction	86	14.0	3.5	17.5
28	Hwy 37: Cranberry Junction-Kitwanga	86	-	3.7	3.7
29	Hwy 16: Kitwanga-Terrace	92	-	-	-
30	Hwy 16: Terrace-Prince Rupert	153	-	-	-
31	Cranberry Junction-New Aiyansh	58	23.2	-	23.2
32	New Aiyansh-Terrace	103	63.0	-	63.0

SOURCE: Highways Design and Survey Branch.

NOTE: Unit costs are those shown in Table 4.7 except as noted below:-

LINK:

2, 29 Additional grade construction costs will be required because of the present, low standard of the road.

3, 11 20, 27 Certain sections of these links are at highway standard and do not require further grade construction or reconstruction.

10 Estimate for upgrading to 8 metre gravel surface.

14-16 The source of information is a 1981 report prepared by Wright Engineers Limited of Vancouver for Hudson Bay Mining and Smelting Co. Limited entitled "Stikine Copper Project, B.C.: Review of Access Alternatives" (1981 costs have been inflated to mid 1982 values)

17 A B.C. Hydro cost estimate for this link is $46.0 million which we felt too high in regard to other link costs

28 Grade construction costs equivalent to Highway 37 were applied.

The capital costs shown in Table 4.8 are considered to be incurred over a three year construction period, with the percentage of expenditures being 40% in the first year, 40% in the second year and 20% in the third year. As noted in Section 2, it is assumed that the construction of mine access roads will be initiated three years in advance of the mine production start. In regard to Highway 37, it has been assumed that links 11, 13, 19, 20, 21, 27 and 28 will be re-constructed in the 1984-85-86 period; so that a uniform, high standard highway will be in place prior to new mines in the region initiating production. (In practice, such re-construction would likely be phased over a longer time period as traffic, on a link by link basis, warrants.) Table 4.9 summarizes road construction costs, by year.

4.1.4 Road Maintenance Costs

A review of maintenance costs on existing public highways in Northwest B.C. indicated that the following annual costs would be reasonable estimates for use in this study.

	$/km
Main trunk, paved	4,500
Principal gravel roads	5,000
Other gravel roads (eg. used for concentrate haul only)	3,500

These unit costs were applied to the links in the road network, beginning the year after the road was constructed, to produce the annual maintenance costs for each link shown in Table 4.10. The year-to-year maintenance costs associated with: 1) the road network linking seven new mines to Stewart and 2) the road network linking the same mines to Prince Rupert are summarized in Table 4.11.

TABLE 4.9
ROAD CONSTRUCTION COSTS, NORTHWEST B.C.
BY YEAR ($ MILLIONS)

($ 1982 Millions)

LINK	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1																		
2		6.6	6.6	3.3														
3		13.4	13.4	6.7														
4		3.2	3.2	1.6														
5					0.4	0.4	0.2											
6		1.2	1.2	0.6														
7										1.2	1.2	0.6						
8		4.4	4.4	2.2														
9																		
10																		
11		16.4	16.4	8.2														
12					0.6	0.6	0.2											
13		11.0	11.0	5.5														
14																		
15															24.0	24.0	12.0	
16															21.6	21.6	10.8	
17															20.9	20.9	10.5	
18							4.8	4.8	2.4						3.6	3.6	1.8	
19		11.0	11.0	5.5														
20		28.0	28.0	14.0														
21		2.2	2.2	1.1														
22					7.6	7.6	3.8											
23											5.9	5.9	2.9					
24											3.6	3.6	1.8					
25											7.8	7.8	4.0					
26											7.6	7.6	3.8					
27		7.0	7.0	3.5														
28		1.5	1.5	0.7														
29		NIL	NIL	NIL														
30		NIL	NIL	NIL														
31																		
32																		
TOTAL		105.9	105.9	52.9	8.6	8.6	9.0	4.8	2.4	1.2	26.1	26.5	12.5		70.1	70.1	35.1	

TABLE 4.10
ANNUAL MAINTENANCE COSTS, BY LINK

Link	Standard	Unit Cost $/km	Distance km	Annual Cost $
1	MT	4,500	122	549,000
2	MT	4,500	15	68,000
3	MT	4,500	114	513,000
4	PG	5,000	40	200,000
5	OG	3,500	5	18,000
6	PG	5,000	15	75,000
7	OG	3,500	15	53,000
8	PG	5,000	55	275,000
9	N/R	-	-	-
10	N/R	-	-	-
11	MT	4,500	82	369,000
12	OG	3,500	7	25,000
13	MT	4,500	55	248,000
14	OG	3,500	16	56,000
15	OG	3,500	54	189,000
16	OG	3,500	67	235,000
17	OG	3,500	45	158,000
18	PG	5,000	60	300,000
19	MT	4,500	55	248,000
20	MT	4,500	146	657,000
21	MT	4,500	67	302,000
22(a)&(b)	N/R	-	-	-
23	OG	3,500	74	259,000
24	OG	3,500	45	158,000
25	OG	3,500	98	343,000
26	OG	3,500	95	333,000
27	MT	4,500	86	387,000
28	MT	4,500	86	387,000
29	MT	4,500	92	414,000
30	MT	4,500	153	589,000
31	N/R	-	-	-
32	N/R	-	-	-

NOTES:

MT = Main Trunk, Paved
PG = Principal Gravel Road
OG = Other Gravel Road
N/R = Not required for concentrate movement in this scenario.

TABLE 4.11
Road Network Maintenance Costs, By Year
(1982 $)

Year	Stewart ($ M)	Serving Prince Rupert
1987	3.0	4.5
1988	3.0	4.5
1989	3.0	4.5
1990	3.0	4.5
1991	3.0	4.5
1992	3.3	4.9
1993	3.3	4.9
1994	3.3	4.9
1995	3.3	4.9
1996	4.4	6.0
1997	4.4	6.0
1998	4.4	6.0
1999	4.4	6.0

4.1.5 Road Haul Costs

In order to estimate truck operating costs for hauling concentrates out of the Northwest a review of previous studies was conducted[1], industry sources were contacted and hourly haul costs were estimated. The latter estimates were compared to industry quotes to ensure that they were consistent with operating experience.

For this analysis it was assumed that a "B-Train" truck configuration would be used for both on and off-highway movements. "B-Trains" consist of two trailers hauled by a 450 h.p. diesel tractor. These units are in the order of 70 feet in overall length with seven or eight axles and have a carrying capacity of about 35-40 tonnes.

Since these trucks can be manufactured in British Columbia capital costs were obtained from local manufacturers.

TABLE 4.12

Capital Costs (1982)

Tractor	$108,000
Trailers* (40 tonne capacity)	$ 50,000
Total Unit	$158,000

* this does not include self-dumping which would add $10,000 - $20,000.

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1 Trimac Consulting Services, "Chetwynd Area Coal Property Road Access Survey and Transportation Cost Estimates", July 1977; ALM Resources, "Technical Paper #2 (Land Access) Vancouver Island Coal Port Evaluation", February 1981; Swan Wooster Engineering Ltd., "A Study of Options of Rail Access to Peace River Coalfields" 1980.

The useful life of a tractor is estimated to be 18,000 hours of running time while the useful life of the trailer is estimated to be 30,000 hours. Assuming 3,000 operating hours per year the useful life of a tractor and trailer is 6 years and 10 years respectively. Hourly capital costs have been calculated using the above assumptions.

Table 4.13 shows the components of hourly truck haul costs. The estimated economic cost of approximately $61 per hour compares favourably to an industry quote of around $65 per hour.

As verification for this cost, rates per tonne mile for existing hauling from the Highland Valley were examined. For instance, a rate of 6.3¢ per short ton/mile was quoted for concentrates being trucked the 423 kilometers (264 miles) from Kamloops to Vancouver. This would be equivalent to a cost per tonne of about $18.30 assuming a payload of 35 tonnes.

Using the hourly rate method, a cost per tonne can also be derived for comparison purposes. Assuming an average speed over 423 kilometres (264 miles) of 80 kilometres per hour (on highway) a round trip would take about 10.6 hours. The total cost would be $646.6 and the cost per tonne, assuming a payload of 35 tonnes, would be about $18.45.

In the Northwest where speeds will likely be slower on mine access roads, the cost per tonne will be higher since travel times will be longer.

TABLE 4.13
Approximate Hourly Truck Haul Costs
(1982 $)

Item	$/hour	Basis for Estimate
Tractor Costs:		
Capital Cost	$9.51	Cost of truck amortized over 6 years at 15%.
Licence Fees	.65	Annual fees on 135,000 gross weight are $1950. (Ministry of Highways)
Repairs	4.00	Based on 1977 Trimac Report and inflated by Stats Canada transport service index (62-010)
Driver (Wages & Benefits)	16.80	Industry quote, includes wages and benefits
Fuel	14.76	Indexed based on Trimac Study from Stats Canada 62-011
Tires	1.56	Indexed based on Trimac study from Stats Canada 62-011
Transport Expense	.24	Indexed based on Trimac study from Stats Canada 62-011
	48.16	
Trailer Costs:		
Capital Cost	$3.32	Cost of trailer amortized over 10 years at 15%
Repairs	2.65	Based on 1977 Trimac Report & inflated by Stats Canada
Transport Expense (tarp cleaning etc.)	.18	Based on 1977 Trimac Report & inflated by Stats Canada
Tires	1.72	Based on 1977 Trimac Report & inflated by Stats Canada.
	7.87	
Other:		
Radio	.33	Assumes $10,000 for fleet
Insurance	2.86	ICBC rate of $8591/year for liability and collision
Overhead	1.50	Assumed
	4.69	
Rate per hour	$60.72*	

* This cost is consistent with cost estimates made recently in a report prepared for the Motor Carrier Branch, Surface Transport Administration, Transport Canada entitled Operating Costs of Trucks in Canada, Trimac Consulting Service Ltd., Calgary, 1982.

To determine the costs using the hourly cost approach, travel times from mine to port or railhead are required. Since capital costs for Highway 37 and 37A (951) are estimated on an 80 km/h standard and mine access roads are costed at a 50 km/h standard, these speeds have been used to calculate travel times. In the case of the Stikine mine, though, travel is expected to be slower up to the B.C. Hydro access road due to the rugged terrain. Times on this route are calculated at 35 km/h. These speeds are consistent with logging truck haul speeds on paved and gravel surfaces[1]. The Ministry of Forests estimate that on paved surfaces the speeds for logging trucks can average around 80 km/h. They state that a loaded truck could make between 49 and 58 km/h highway hauling on an average condition gravel surface road, where the grades were no worse than 3%. Where adverse grades are as much as 7% this average speed drops to about 35 km/h.

Tables 4.14 and 4.15 show the estimated truck haul costs for each mine to port option. An estimated loading charge is also included in order to obtain a delivered cost to the port. A typical loading cost was quoted by British Columbia shippers to be $0.90/tonne.

By way of example costs of hauling from Kutcho Creek to Stewart are estimated to be as follows. The round trip travel time from Kutcho Creek to Stewart is estimated to be 16.3 hours (4.4 hours on mine access roads and 11.9 hours on highway). At $61/hour this would cost $994.30 per trip or $28.40/tonne. In addition a loading cost of about $.90 per tonne would be incurred.

1 Ministry of Forests, "Logging Truck Haul Speeds", Victoria, 1981

TABLE 4.14
Estimated Truck Haul Costs
Minehead to Stewart
(Mid 1982 Canadian Dollars)

Mine	Return Travel Time (Hours)	Haul Cost/ Tonne	Estimated Loading Cost/ Tonne	Tonnes/ Year	Total Annual Haul Cost ($ million)	Unit Cost/ Tonne
Kutcho	16.3	$28.40	$.90	120,000	$3.5	$29.30
Letain	14.9	25.97	.90	50,000	1.3	26.90
Red Chris	10	17.43	.90	37,000	0.7	18.30
Schaft Creek*	9.1	15.86	.90	500,000	8.4	16.80
Schaft Creek**	19.1	33.29	.90	500,000	17.1	34.20
Eaglehead	14.7	25.58	.90	50,000	1.3	26.50
Sustut	11.2	19.52	.90	100,000	2.0	20.40
Stikine	14.9	25.97	.90	350,000	9.4	26.90

TABLE 4.15
Estimated Truck Haul Costs
Minehead to Prince Rupert (via Kitwanga)
(Mid 1982 Canadian Dollars)

Mine	Return Travel Time (Hours)	Haul Cost/ Tonne	Estimated Loading Cost/ Tonne	Tonnes/ Year	Total Annual Haul Cost ($ Million)	Unit Cost/ Tonne
Kutcho	26.7	$46.53	$.90	120,000	$5.7	$47.40
Letain	25.3	44.09	.90	50,000	2.3	45.00
Red Chris	20.4	35.55	.90	37,000	1.4	36.50
Schaft Creek*	19.5	33.99	.90	500,000	17.5	34.90
Eaglehead	25.1	43.75	.90	50,000	2.2	44.70
Sustut	21.6	37.65	.90	100,000	3.9	38.60
Stikine	25.3	44.09	.90	350,000	15.8	45.00

* Via Raspberry Pass
** Via Telegraph Creek

4.1.6 Present Value of Concentrate Transport Costs, by Road

This analysis assumes that Highways 37, 37a and common user roads to proposed townsites would be constructed and maintained at public expense and that mine developers would bear the costs of constructing and maintaining access roads to the mine sites from the common user road; as well as all costs for the transportation of concentrates (or minerals).

Given these assumptions, the estimated present value (PV) of public sector costs for upgrading existing highways, constructing common user roads and maintaining them during the study period are estimated to be as follows for the route networks to Stewart and Prince Rupert:-

Table 4.16

Present Values
Public Sector Road Costs
($ Millions)

Cost	To Stewart	To Prince Rupert
Upgrading and Construction	140	152
Maintenance	11	19
	151	171

NOTES:

1) The public sector links include 6,8,11,13,19,20,21,27 and 28 (see Figure 3.2).

2) In order to calculate these costs, the mine start dates shown in Scenario 1 (see Section 2) and a discount rate of 10% were assumed.

Table 4.17, following, shows the PV of private sector road transport costs. The unit costs shown in the table represent the sum of access roads and haul costs divided by the present value of the mine outputs. It can be noted that unit costs to Stewart are generally significantly lower than to Prince Rupert.

TABLE 4.17

NET PRESENT VALUES
PRIVATE SECTOR ROAD TRANSPORTATION COSTS

(1982 Dollars)

TO STEWART FROM:	ACCESS ROAD COSTS CONSTRUCTION	ACCESS ROAD COSTS MAINTENANCE	HAUL COSTS TO: STEWART	HAUL COSTS TO: PRINCE RUPERT	TOTAL COSTS STEWART	TOTAL COSTS PRINCE RUPERT	PRESENT VALUE OF VOLUME	UNIT COSTS STEWART	UNIT COSTS PRINCE RUPERT
	$Millions	$Millions	$Millions	$Millions	$Millions	$Millions	Tonnes	$/Tonne	$/Tonne
Kutcho	6.1	0.9	15.2	24.6	22.2	31.6	518,400	42.90	61.10
Letain	0.6	0.1	4.5	7.5	5.2	8.2	167,900	30.60	48.50
Eaglehead	1.1	0.1	2.8	4.7	4.0	5.9	104,200	38.30	56.50
Red Chris	0.8	0.1	2.5	5.1	3.4	6.0	139,900	24.40	43.00
Schaft Creek	5.7	1.1	28.0	58.3	34.8	65.1	1,671,000	20.80	38.90
Sustut	15.1	1.2	2.7	5.5	17.0	21.8	129,700	145.90	167.50
Stikine	25.3	0.4	13.7	23.0	39.4	48.7	510,200	77.30	95.50
	54.7	3.9	69.4	128.7	128.0	187.3			

(1) NPV based on 10% discount rate.

When comparing the two sets of costs, it should be noted that the private sector costs for constructing and maintaining roads would be about $60 million while the public sector capital and maintenance costs would be about $150 million (to Stewart). Although the public/private split is arbitrary, it does indicate that a large percentage (about 70%) of the infrastructure costs in this case would likely be public.

To determine the total costs of this transportation option the public and private sector costs should be added. The total cost of this option in present value terms is estimated to be about $277 million.

4.2 Coal Transportation by Rail

4.2.1 Network

There are four alternative rail networks in the base case for moving coal from Mount Klappan to Prince Rupert. These are discussed earlier in Section 3.2.2 and are shown in Table 3.3. The alternatives are:-

1) BCR grade and track to Prince George; CNR to Prince Rupert
2) BCR grade and track to Fort St. James; new link to Vanderhoof; CNR to Prince Rupert.
3) BCR grade and track to Suskeena; new link via the Skeena to Hazelton; CNR to Prince Rupert.
4) BCR grade and track to Jackson Flats; new link via Meziadin to Terrace; CNR to Prince Rupert.

As well as rail access the Mount Klappan coal project would require road access for mine workers and supplies. Road access would likely be via the Nass River Valley to connect with Highway 37 near Meziadin. Another route, which would be less desirable from the employee's perspective, would be north along

the existing BCR grade to about McEwan Creek, where the distance between Highway 37 and the BCR is minimal. The estimated 1982 capital cost for these routes is $39 million for the former and $22 million for the latter. These routes and their associated costs are discussed more fully in the Appendix which also discusses the costs of transporting one million tonnes of coal by truck to Stewart over one of these routes.

4.2.2 Traffic on Network

The potential traffic on each of the above rail networks from Klappan coal is estimated at 5 million tonnes per year beginning 1990 and continuing at this level until the end of the study period.

4.2.3 Rail Rehabilitation and New Construction Costs, By Link

Costs are estimated for the rehabilitation of the BCR Dease Lake Extension south of Klappan to unit train standard and for the construction of three alternative new lines connecting the BCR extension to the CNR main line respectively at Vanderhoof, Hazelton or Terrace also to unit train standard[1]. It is assumed that in each alternative rehabilitation and/or new construction would begin in 1986 and take approximately three years with 25% of the costs incurred in the first year, 25% in the second year and 50% in the third year.

In order to estimate the costs of rail rehabilitation and/or new construction a literature review was conducted. Previous cost estimates were available for certain sections of the proposed routes but the costs were for branchline standard of

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1) Two railroad construction standards will be discussed in this report. Unit train standard requires heavier rails and more ballasting to support the weight of a unit train normally carrying 95-100 loaded cars of all the same commodity. Branchline standard can be of lighter rails and requires less ballasting. A rail line constructed to branchline standard is designed to carry smaller trains of less than 80 cars of various commodities.

construction, not for unit train standard. Therefore, adjustments to these previous estimates were required before they could be used for estimating the cost of constructing the various lines to the desired standard.

Further these historic costs were updated to mid-1982 dollars using the B.C. Highways Construction Cost Index.

Table 4.18 summarises the above capital cost estimation process. In the table, capital costs are identified for each rail link in the four rail networks comprising the base case. New construction costs pertain to those rail lines which have yet to be designed and constructed (Vanderhoof, Hazelton and Meziadin connectors); upgrade costs pertain to the rehabilitation of grade and track to the desired standard on the BCR Dease Lake Extension.

The above link costs were then allocated to the four alternative rail networks in the base case to produce the low capital cost estimates shown in Table 4.19.

TABLE 4.18

Rail Link Construction Costs (Mid 1982 $ Millions)

LINK	DESCRIPTION	APPROXIMATE LENGTH (KM)	CAPITAL COST	
			NEW CONSTRUCTION	UPGRADE
3	Klappan-Jackson Flats	71	-	42.8
4	Jackson Flats-Suskeena	74	-	44.8
5	Suskeena-Leo Creek	204	-	91.5
6	Leo Creek-Fort St. James	127	-	39.5
7	Fort St. James-O'Dell	117	-	36.5
8	O'Dell-Prince George	53	-	-
9	Fort St. James-Vanderhoof	61	36.6	-
10	Jackson Flats-Meziadin	161	170.5	-
12	Suskeena-Hazelton	195	206.9	-
13	Meziadin-Terrace	209	178.1	-
14	Prince George-Vanderhoof	124	-	-
15	Vanderhoof-Endako	61	-	-
16	Endako-Smithers	201	-	-
17	Smithers-Hazelton	74	-	-
18	Hazelton-Terrace	138	-	-
19	Terrace-Prince Rupert	153	-	-

NOTES:

The capital cost estimates for links No. 3-7 and 9-13 are estimates for construction to unit train standard.

LINKS:

3&4 The source of information was the Royal Commission Report on the BCR, 1977, Volume 2, Part 4, p. 79. In 1977, the BCR estimated that it would cost $160 million to complete the branchline from Leo Creek to Dease Lake to branchline standard.

In 1981, the BCR prepared a brief estimating that it would cost about $10 million to rehabilitate the branchline from Leo Creek to Driftwood, which is operating at branchline standard.

Both the 1977 and 1981 estimates were updated to mid-1982 dollars ($227 million and $10.3 million respectively), then $10.3 million is subtracted from $227 million ($216.7 million) to more accurately reflect the cost of completing the line from Driftwood to Dease Lake.

$216.7 million is divided by the length of the line (430 km) from Driftwood to Dease Lake to determine cost per km ($504,000) of completing the construction to

branchline standard. This unit cost is increased by 20% ($604,800 per km.) on links where unit train standards of construction are required.

5 The cost of completing construction on the 95 km section from Suskeena to Driftwood is calculated at $604,800 per km, while the cost of upgrading the 109 km section from Driftwood to Leo Creek is calculated at $311,000 per km ($500,000 per mile). The cost to upgrade operational branchlines to unit train standard is estimated to be approximately $500,000 per mile.

6,7 The cost of upgrading the branchline from Leo Creek south to O'Dell for 244 km to unit train standard is calculated at $311,000 per km.

8, 14-19 These links are part of the BCR mainline and the CNR northline, both of which are currently being upgraded to unit train standard. No additional costs will be required for these links.

9 This link will require all new construction. No cost estimates were available for this link. Therefore, it was estimated by applying the unit cost of construction of the adjacent Takla Lake branchline (Fort St. James to Leo Creek). This unit cost updated to mid-1982 dollars is $545,000 per km for construction to branchline standard. Cost to construct a new line to unit train standard is estimated to be approximately 10% higher than the cost to construct a new line to branchline standard. Therefore, the cost of constructing this link to unit train standard is estimated at $600,000 per km.

10, 12, 13 The source of information was the B.C. Rail Location Study, a 1973 report by Transport Canada. This report provides estimates made by the CNR for these three links. However, the length of the links CNR estimated differ slightly from the links reported here due to minor routing differences. Therefore, the cost estimates were adjusted in amounts proportional to differences in length of the links.

TABLE 4.19

RAIL CONSTRUCTION COSTS, BASE CASE

Route	Estimated Capital Cost (1982 $M)	
	Low Estimate	High Estimate
Klappan to Prince Rupert via:		
Prince George	255	280
Vanderhoof Connector	255	288
Hazelton Connector	294	365
Meziadin Connector	391	500

Recent rail construction experiences indicate the above low estimates may understate costs for rail route design engineering, construction management and other unforeseen work. In order to account for possible understatements, a set of high estimate costs were developed which are also shown in Table 4.19. These high estimates were determined by increasing link-upgrade costs by 10% and link-new construction costs by 30%.

The cost estimates shown in both Tables 4.18 and 4.19 should be used with caution as they are based on preliminary route location work from a number of sources. No detailed engineering studies have been carried out and consequently the cost estimates should be used as "pre-feasibility" figures only. If rail transportation appears to be a feasible option, detailed studies will be required as a basis for cost estimates and selection of a preferred route.

4.2.4 Rail Haul Costs to Port

The rail haul costs for the transportation of coal in unit trains, from Klappan to Prince Rupert, were estimated using the computer model developed by Swan Wooster Engineering Co. Ltd. The input data required for the model included the rail construction costs, description of the terrain in terms of

gradient and curvature; wages for crew, fuel cost, maintenance cost of equipment and track, lengths of links in the rail network; volume of traffic to be moved each year on each link, minimum speed on each line; and other information pertinent to railway operation. The model assumes that there would be no backhaul traffic and that the coal will be shipped in unit trains of 98 cars.

Output from the operation of the model includes:-

- track maintenance costs, by each link in a route
- rolling stock capital costs
- BCR operating costs
- CNR operating costs

Table 4.20 summarizes the rail haul costs produced by the model. These costs are expressed in 1982 present values, assuming various discount rates are applied to the previous low and high capital costs estimates. Table 4.20 indicates that the least cost rail route from Klappan to Prince Rupert would be via the Hazelton connector; then, in successive, higher cost order, via the Meziadin connector, the Vanderhoof connector with the highest cost via Prince George. For example, with reference to part (b) of Table 4.20, the estimated net present value of the cost via Hazelton would be $405 million, assuming a 10% discount rate ($483 million with an 8% discount rate; $345 million with a 12% discount rate).

TABLE 4.20(a)

PRESENT VALUE OF RAIL TRANSPORTATION COSTS[1]
(1982 $ Millions)

Present Value Costs @ 10% Discount Rate	Via Prince George	Via Vanderhoof Connector	Via Hazelton Connector	Via Meziadin Connector
Capital	155	155	179	238
Fixed Maintenance of Way	8	7	5	6
Rolling Stock Capital	28	23	14	12
BCR Operating	168	140	91	120
CNR Operating	183	151	73	39
Total	542	476	362	415
Total Present Value Costs @ 8%	675	590	436	494
Total Present Value Costs @ 12%	442	391	305	355

(1) Low Capital Cost Case

TABLE 4.20(b)

PRESENT VALUE OF RAIL TRANSPORTATION COSTS[1]
(1982 $ Millions)

Present Value Costs @ 10% Discount Rate	Via Prince George	Via Vanderhoof Connector	Via Hazelton Connector	Via Meziadin Connector
Capital	171	175	222	304
Fixed Maintenance of Way	8	7	5	6
Rolling Stock Capital	28	24	14	12
BCR Operating	168	140	91	121
CNR Operating	182	151	73	39
TOTAL	557	497	405	482
Total Present Value Cost @ 8%	693	612	483	567
Total Present Value Cost @ 12%	456	409	345	415

(1) High Capital Cost Case (Costs are increased from the previous table by 30% for new rail and 10% for upgrading costs).

Table 4.21 summarises the unit costs for each rail alternative, low and high capital cost estimates, assuming discount rates of 8%, 10% and 12%.

TABLE 4.21

Unit Coal Train Costs ($/Tonne)

Klappan to Prince Rupert

Low Capital Cost Estimate	Via Prince George	Via Vanderhoof Connector	Via Hazelton Connector	Via Meziadin Corrector
	$/Tonne	$/Tonne	$/Tonne	$/Tonne
Discount Rate - 8%	23.10	20.20	14.90	16.90
- 10%	24.50	21.50	16.30	18.70
- 12%	25.90	22.90	17.90	20.20
High Capital Cost Estimate				
Discount Rate - 8%	23.70	20.90	16.50	19.40
- 10%	25.10	22.40	18.30	21.70
- 12%	26.70	23.90	20.20	24.20

5.0 ALTERNATIVE TRANSPORTATION CASES

This section reviews alternative transportation options to the base case. These options include: the shipment of concentrates by a combination of road and rail along with coal by rail to either Stewart or Prince Rupert and the shipment of coal by slurry pipeline from Klappan to Stewart.

5.1 Case No. 2: BCR Extension from Klappan to Dease Lake

5.1.1 Traffic

Output from five mines (Kutcho, Letain, Eaglehead, Red Chris and Sustut) would be trucked to railheads on the BCR for transportation to Prince Rupert. Eventually there could be 357,000 tonnes of copper and zinc concentrates and other minerals shipped annually by rail which would be additional to the coal shipments from Klappan moving over the preferred rail network to tidewater.

5.1.2 Road Construction and Maintenance Costs

The extensive use of rail transportation in this case would greatly reduce the requirements for (1) upgrading certain sections of the public highway system and (2) new road construction to Sustut. Potential avoidable roads costs expressed in 1982 present value terms are shown in Table 5.1.

TABLE 5.1
Potential, Avoidable Road Costs

Link No. (See Figure 3.2)	Description	Classification	Avoidable Cost ($ Millions - 1982 present value)
11 & 13	Highway 37 upgrading between Dease Lake and Eastman Creek	Public	52.6
25 & 26	Mine access road construction to Sustut, between Meziadin Junction and Suskeena	Private	12.6
11,13,25, 26	Road Maintenance	Public and Private	0.6
			65.8

However, a new private sector road would be required between Red Chris and the railhead on the BCR Dease Lake Extension at McEwan Creek. The estimated cost of this new link would be about $8 million in 1982 present value terms. This new link might eliminate the requirement for a link to Highway 37 (shown as link 12 in Figure 3.2) in which case $800,000 (1982 present value) in road construction costs could be avoided.

In summary, potential private sector avoidable costs would be $5-6 million and potential public sector avoidable costs would be about $53 million in present value terms. All other road construction, upgrading and maintenance costs described in the base case would be incurred.

5.1.3 Road Haul Costs

Table 5.2 summarizes the estimated truck haul costs from each mine to the nearest railhead. Output from Kutcho, Letain and Eaglehead would be trucked to a Dease Lake rail terminal; Red Chris concentrates would go to McEwan Creek and Sustut concentrates would go to either Suskeena or Jackson Flats depending on which rail network is being considered.

It has been assumed that concentrates from Schaft Creek and Stikine would not be shipped by rail since useage of rail would unnecessarily extend transportation distances from each mine to tidewater port.

Truck haul times shown in the table are round trip times calculated at 50 km/hour. Haul costs were calculated using hourly costs derived in Table 4.13 and assume 35 tonne payloads per trip. Costs for loading concentrates at the mine and transferring them from road to rail transport are based on present rates in other parts of British Columbia.

TABLE 5.2

Case No 2: Annual Road Haul Costs

Mine	Railhead/ Other Destination	Traffic (Tonnes/ Year)	Truck Haul Distance (km)	Truck Haul Return Travel (hrs)	Truck Haul Cost/ Tonne	Loading/ Transfer/Cost Tonne	Annual Cost ($ M)	Net Present Value ($ M)
Kutcho	Dease Lake	120,000	110	4.4	$ 7.67	$0.90	1.03	6.60(1)
Letain	Dease Lake	50,000	75	3.0	$ 5.23	$0.90	0.31	1.00
Eaglehead	Dease Lake	50,000	70	2.8	$ 4.88	$0.90	0.29	0.60
Red Chris	McEwan Creek	37,000	50	2.0	$ 3.49	$0.90	0.16	0.60
Sustut	Suskeena	100,000	45	1.8	$ 3.14	$0.90	0.39	0.55
Sustut	Jackson Flats	100,000	119	4.8	$ 8.30	$0.90	0.92	1.20
Schaft Creek	Stewart	500,000	328	9.1	$15.86	$0.90	8.40	28.0
Stikine	Stewart	500,000	394	14.9	$25.97	$0.90	9.40	13.7

NOTE:

1) This amount includes truck haul costs from Kutcho to Stewart, for two years, until the railway network is extended to Dease Lake.

5.1.4 Rail Rehabilitation and New Construction Costs

The Klappan-Dease Lake line is shown as links 1 and 2 in Figure 3.4.

The distance from Klappan to Dease Lake is 190 km. The estimated capital cost for the rehabilitation of this section of the BCR Dease Lake Extension, to a standard capable of carrying concentrate trains, ranges from $96 to $106 million in 1982 dollars[1]. In present value terms, assuming a three year construction period beginning in 1986[2] and a 10% discount rate, the construction cost would be from $58 to $65 million. Capital costs for the rail network south of Klappan were discussed in Section 4.

5.1.5 Rail Haul Costs

Swan Wooster Engineering Co. Ltd. was retained to develop a model to estimate rail haul costs for mixed freight traffic[3]. The model simulates the operation of way and through freight trains which transport concentrates and other commodities in contrast to unit trains which carry coal. To do this, input with respect to the rail network and quantities of commodities to be shipped is required. The model then determines the number of trains required, the rolling stock capital costs, operating costs and allocates the construction capital costs to each product.

1) BCR estimates for low range plus 10% contingency for high range.

2) It is assumed that the Klappan-Dease Lake rail line will be constructed in the same time period as the lines south of Klappan. It would not be economically feasible to build the rail network simply to serve Kutcho Creek mine.

3) Swan Wooster Engineering Co. Ltd., "Rail Systems Operation/ Cost Model of Way and Through Freight Trains", for Ministry of Industry and Small Business Development, Victoria, B.C., January, 1983.

The model (which is still in a developmental process) tentatively indicates that the least cost route for each concentrate haul would be via the Hazelton connector which was described in Section 4.

Using the Hazelton route, the estimated present value costs of the operating and rolling stock for each property is shown in the table following.

TABLE 5.3

Present Value Costs for the Transportation of Concentrates by Rail to Prince Rupert
(1982 $millions; 10% discount rate)

	Operating[1] ($M)	Rolling Stock ($M)	Total ($M)
Kutcho[2]	5.65	1.05	6.70
Letain	2.25	0.33	2.58
Red Chris	1.61	0.25	1.86
Eaglehead	1.42	0.21	1.63
Sustut	0.95	0.18	1.13
TOTAL	11.88	2.02	13.90

(1) These costs have been allocated to each mine on the optimistic assumption that there will be 250,000 tonnes of backhaul traffic. As backhaul traffic declines the operating costs allocated to each mine increase.

(2) Assumes road transportation to Stewart will be used for the first two years of the mine's life.

5.1.6 Unit Costs

The unit costs for each product are shown in Table 5.4. Unit costs are calculated by dividing the present value of costs by the present volumes of the traffic to be transported.

TABLE 5.4
Unit Costs for the Transportation
of Concentrates and Coal by Rail to Prince Rupert[1]

	Operating ($/Tonne)[2]	Rolling Stock ($/Tonne)	Capital ($/Tonne)	Total[3] ($/Tonne)
Kutcho	11.65	1.67	32.09	45.41
Letain	11.20	1.65	31.74	44.59
Red Chris	9.82	1.51	18.72	30.05
Eaglehead	11.42	1.66	32.25	45.33
Sustut	5.67	1.10	3.21	9.98
Klappan	5.11	1.52	4.62	11.25

NOTES:

1) Route is the least cost route using the previously described Hazelton connector.
2) Discount rate is 10%.
3) Assumes a backhaul of 250,000 tonnes.

It should be noted that the capital portion of these unit costs is determined on a traffic basis; that is each shipper shares in the capital costs proportionate to the gross tonne - kilometers incurred by the shipper's traffic.

For example if Klappan mine ships 5 million tonnes per year its annual capital contribution would be $23.1 million; in contrast Kutcho would contribute only $3.85 million for a longer route but for a smaller volume of traffic. If all potential developments did not proceed and only one or two of the mines were to come into production the capital contributions for mines in production would increase substantially unless additional traffic (eg. forest products, backhaul traffic to the mines) could be generated.

5.2 Case No 3: Construction of a Railway to Stewart

This case considers the construction of a railway to Stewart for the shipment of concentrates from the five mines discussed in Case Two and coal from Klappan. It is assumed that Stikine and Schaft Creek would truck concentrates to Stewart in this case.

5.2.1 Traffic

As in Case No. 2 output from five mines (Kutcho, Letain, Eaglehead, Red Chris and Sustut) would be trucked to railheads on the BCR for transportation to Stewart. Eventually there could be 357,000 tonnes of copper and zinc concentrates and other minerals shipped annually by rail which would be additional to the coal shipments from Klappan.

5.2.2 Road Construction and Maintenance Costs

The cost savings for public roads in this case would be equivalent to those in Case 2. For the private sector, costs would likely be reduced by only $3.2 million in 1982 present value terms from the base case because of the requirement to construct a new road between Suskeena and the railhead at Jackson Flats.

5.2.3 Road Haul Costs

The road haul costs would be the same in this case as in Case 2 except for Sustut. In Sustut's case, since the rail route would "turn" west north of Sustut at Jackson Flats, haul costs would be higher for that mine. The annual road haul cost is estimated to be $920,000 (in 1982 dollars) and the present value of the amount from mine start up to the year 2000 would be about $1.2 million.

5.2.4 Rail Rehabilitation and New Construction Costs

The estimated capital cost of providing a rail network between Dease Lake and Stewart using the existing BCR route to the extent possible is estimated to be between $380 million and $470 million. Making the same assumption as in Case 2 with respect to construction timing and discount rates, the present value of this route is estimated to be between $231 and $286 million (1982 dollars).

5.2.5 Rail Haul Costs

The Swan Wooster unit coal and through freight train models were used to calculate the costs for hauling concentrates and coal to Stewart by rail. The estimated costs are shown below.

TABLE 5.5
Present Value Costs for the Transportation of Concentrates and Coal by Rail to Stewart
(1982 $millions, 10% discount)

	Operating[1] ($M)	Rolling Stock ($M)	Total ($M)
Kutcho[2]	2.80	1.60	4.40
Letain	1.15	0.50	1.65
Red Chris	0.75	0.40	1.15
Eaglehead	0.73	0.30	1.03
Sustut	0.67	0.30	0.97
Klappan	80.00	6.90	86.90

(1) Assumes backhaul traffic of 250,000 tonnes (see note 1 Table 5.3).
(2) The first two years of operating costs were deducted from Swan Wooster totals since the traffic will go by road.

5.2.6 Unit Costs

The estimated unit costs for this case are shown in Table 5.6. The same caveats noted for Case 2 should be borne in mind.

TABLE 5.6
Unit Costs for the Transportation of
Concentrates and Coal by Rail to Stewart

	Operating $/tonne	Rolling Stock $/tonne	Capital $/tonne	Total $/tonne
Kutcho	5.77	2.63	30.40	38.80
Letain	5.74	2.65	30.85	39.25
Red Chris	4.58	2.50	17.88	24.96
Eaglehead	5.85	2.66	31.40	39.90
Sustut	4.00	2.06	7.16	13.22
Klappan	3.60	0.31	4.57	8.48

NOTES:

(1) Operating and rolling stock costs obtained from Swan Wooster unit train cost model; capital costs from its through freight train model.

(2) Discount rate of 10%.

5.3 Case 4: Construction of a Coal Slurry Pipeline from Klappan to Stewart; Concentrates by Road to Stewart as in Base Case

Gulf Canada Resources has indicated that preliminary testing on its coal property located near Mt. Klappan, adjacent to Spatsizi Plateau Wilderness Park in Northwestern British Columbia may warrant a coal mine with an ultimate capacity of five million metric tonnes of anthracite coal per year.

If this coal were destined for export, one potential transportation option may be a coal slurry pipeline from the minesite to a terminal at Stewart. The feasibility of this option is being assessed to determine whether or not, on an economic basis, this option would be more or less attractive than rail or trucking.[1]

5.3.1 Routing

A possible alignment for a coal slurry pipeline would be as follows:

1. This analysis assumes that current technology is well enough advanced to transport anthracite coal in water slurry.

from the minesite south along the B.C. Rail Dease Lake Corridor to Beirnes Creek, the route would then turn southwest and follow the proposed railway to Stewart, essentially along the Nass River to Highway 37, would then follow the Highway from Meziadin to Stewart. The approximate distance of this route is 250 km (156 M).

5.3.2 System Size

The only operating system in North America is the Black Mesa Slurry Pipeline which transports about 5 million tonnes of thermal coal yearly over 283 miles in an 18" pipeline. Since the amount of coal to be delivered on an annual basis from Mt. Klappan is approximately equivalent to the Black Mesa system, it is assumed a similar sized pipeline would be required.

The other significant variable in determining system size is the number of pumping stations required. Current technology suggests that pumping stations are required every 70 to 100 miles[1] thus the 156 mile Mt. Klappan - Stewart system would require two pumping stations. This is consistent with the preliminary design of the potential Alberta - Kitimat coal slurry system.[2]

Finally, for this analysis, it is assumed that it would be an open system with no water recycling.

5.3.3 Capital Cost Estimates

The basis for estimating the order of magnitude capital costs for a pipeline such as that described above is the 1981 Alberta, Coal Slurry Pipeline Feasibility Study. While that is a much larger system (10.2 million tonnes per year to be transported over 673 miles) costs can be factored down based on the

1. Coal Slurry Pipelines, Centre for Advanced Computation Universities, University of Illinois, 1977

2. Alberta Coal Slurry Pipeline Feasibility Study 1981, Fluor Canada, Calgary, 1981.

parameters noted above. The following table (5.7) shows how the order of magnitude capital cost estimate of $323.6 million (1981) was arrived at. Inflating that by 10% to mid 1982 dollars gives a capital cost of $356.0 million.

5.3.4 Operating and Maintenance Costs

Since the proposed pipeline system is approximately one fourth the distance of the proposed Alberta system, operating and maintenance costs will necessarily be much lower than that system. The consultants estimated operating costs to be in the order of $60.8 million per year for the 10.2 million tonne system over 653 miles. Factoring those costs down in accordance with the shorter distance and smaller capacity system yields an operating cost estimate of $21.1 million per year (see Tables 5.8 and 5.9). In mid 1982 dollars this would be about $23.2 million.

TABLE 5.7
Construction Cost Distribution
(thousand's 1981 Canadian dollars)

Base Case 10.2 MT/Year[1]

	Prep Plant	Water Gathering	Coal Receiving	Slurry Pipeline	Pump Stations	Dry Bulk Terminal	Total Cost
Basis for estimate	5 prep plants @ 2 MT/y capacity	single source delivered to five plant	10.2 MT/ year	673 miles primarily 24" pipe	7 Pump Stations Average 5 pumps 1 spare	Dewatering Facilities for 10.2 MT capacity excluding loading dock & coal loading	
Cost* Estimate	$91,380	$127,875	$23,250	$936,000	$226,132	$120,814	$1,525,421

Estimate for 5 MT/year Slurry Pipeline Mt. Klappan - Stewart

Basis for estimate	-1 prep. plant @ 5MT/y capacity -cost estimated to be approx. equiv. to that of 2 plants above	-single source delivered to single plant assumes 30 miles of line.	-not required with only 1 prep plant	-156 miles @ 18" pipe Current estimates suggest a cost of $160/foot for similar a sized line in similar terrain	-2 pump stations -3 pumps 1 spare at each station	Dewatering only for half capacity therefore assume 55% of costs	
Cost* Estimate	$36,552	$45,772		$131,790	$43,000	$ 66,448	$323,562

* All costs include 25% contingency.

1. Source: Chapter 7.0 (System Description) and Chapter 9.0 (Cost Estimate), "Coal Slurry Pipeline Feasibility Study 1981," Fluor Canada, Calgary, 1981. MT/Y = Million tonnes per year.

TABLE 5.8
ESTIMATED ANNUAL OPERATING & MAINTENANCE COSTS OF PROPOSED ALBERTA COAL SLURRY PIPELINE

BASE CASE
(Stated in Thousands of Canadian Dollars)

ITEM	PREPARATION PLANTS	WATER GATHERING	FEEDER PIPELINE STATION	FEEDER PIPELINE PIPELINE	MAIN PIPELINE STATIONS	MAIN PIPELINE PIPELINE	TERMINAL 55WT	TERMINAL 60WT	TERMINAL DRY
Maintenance Manpower	748	(1)	(1)	(2)	952	(2)	436	565	565
Maintenance Material & Control Labour	550	150	110	65	81	327	353	1,608	2,356
TOTAL MAINTENANCE EXPENSES	1,298	150	110	65	1,033	327	789	2,173	2,921
Operating, Security & Engineering Manpower	1,690	(1)	(1)	(2)	1,046	(2)	1,267	1,370	1,370
Consumable Supplies	148	55	210	(1)	2,898	(2)	413	3,545	8,071
Utilities	4,185	1,026	802	-	7,220	-	246	1,291	1,857
Wastewater Treatment	-	-	-	-	-	-	3,600	10,800	10,800
TOTAL OPERATING EXPENSES	6,023	1,081	1,012	-	11,164	-	5,526	17,006	22,098
Administrative Manpower	129	(1)	(1)	(1)	440	(2)	219	219	219
Service	512	86	78	5	854	23	190	587	995
Insurance	2,049	345	314	18	3,415	93	760	2,346	3,981
TOTAL ADMINISTRATIVE EXPENSES	2,690	431	392	23	4,709	116	1,169	3,152	5,195
TOTAL ESTIMATED ANNUAL EXPENSES	10,011	1,662	1,514	88	16,906	443	7,484	22,331	30,214

NOTES:

(1) Included with Preparation Plant
(2) Included with Mainline Pump Station

SOURCE:

Fluor Canada, Calgary, 1981

TABLE 5.9

Estimated Annual Operating and Maintenance Cost,
Klappen - Stewart Pipeline
($000, 1981)

Expenses	Preparation Plants	Water Gathering	Main Pipeline(2)	Terminal	Total
Maintenance	454	53	340	1,103	1,950
Operating	2,108	379	2,791	9,637	14,915
Administrative	941	150	1,206	1,948	4,245
TOTAL	3,503(1)	582(1)	4,337(3)	12,688(4)	21,110

NOTES:

(1) Assumes 35% of cost of Alberta pipeline

(2) Includes cost of feeder pipeline.

(3) Assumes 25% of the distance of proposed Alberta coal slurry pipeline.

(4) Assumes 50% of capacity of proposed Alberta pipeline and excludes loading dock.

5.3.5 Present Value of Slurry Pipeline Costs

Assuming the start date for shipping coal to be 1990 the 5-year construction of the pipeline would have to begin in 1985. It is further assumed that the capital cost would be incurred in equal annual increments beginning in 1985. At a 10% discount rate the present value of such capital costs would be $223 million, the operating costs would be $92 million, for a combined total of $315 million.

Dividing this total by the present value of the mine outputs yields a pipeline haul cost of $14.43 per tonne. By comparison, at an 8% discount rate, the unit cost would be $12.73 per tonne and at a 12% discount rate, the unit cost would be $16.33 per tonne.

The above calculations exclude the capital and operating costs associated with the loading dock and coal loading facilities required at Stewart which would be costs common to any mode of transport used to haul coal to Stewart.

6.0 MARINE TRANSPORTATION

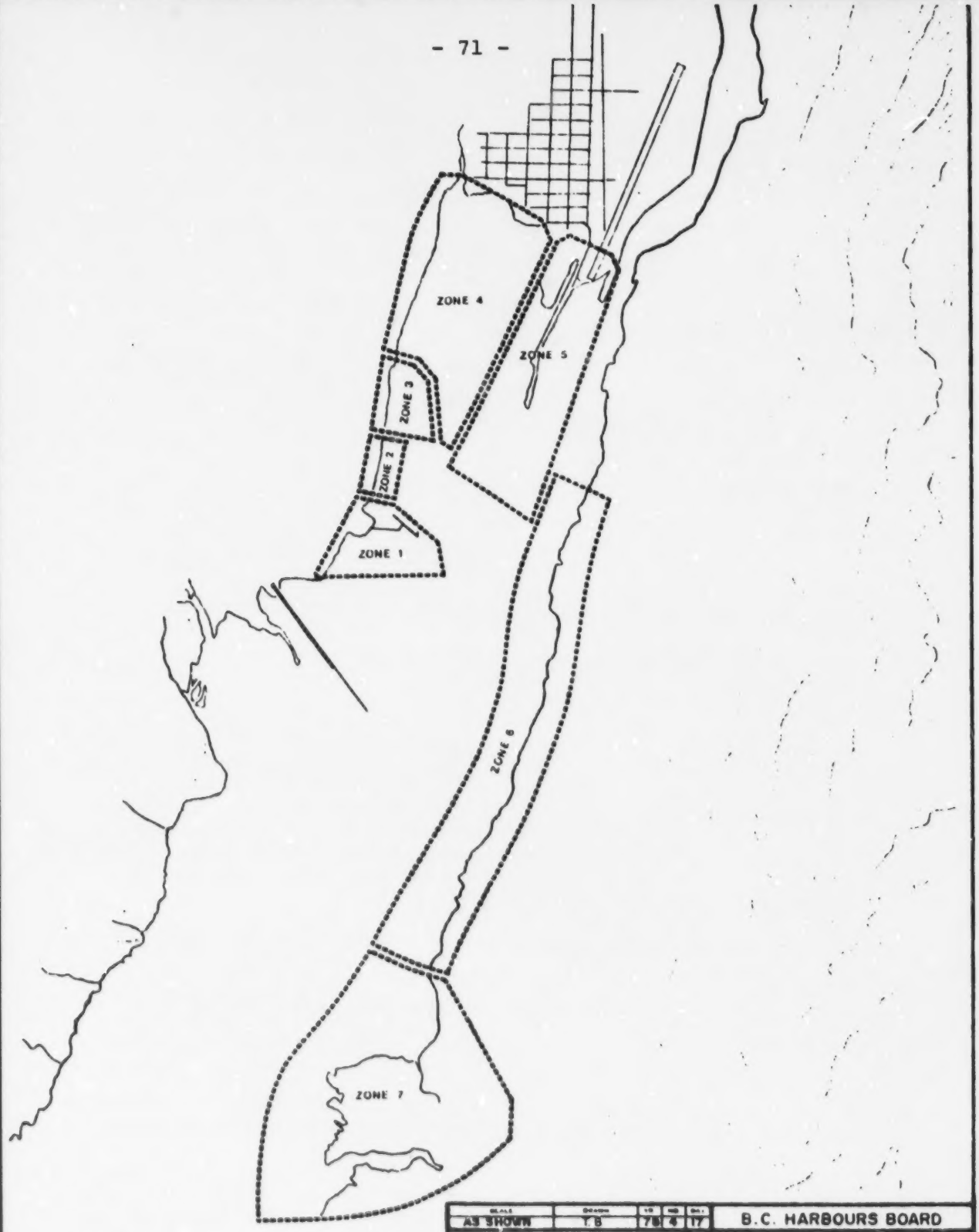
While Stewart is the nearest British Columbia tidewater location to the resource base of the Northwest, and therefore appears to be the preferred port from the perspective of land transportation, it does have limitations and thus potentially greater costs when considering marine transportation.

The issue of port and ocean transportation costs is examined to determine the added marine related costs of using Stewart rather than Prince Rupert. This analysis does not take into account who bears this added cost (i.e. whether it is the shipper or the purchaser of the resource), rather it just examines the incremental marine costs of moving commodities through Stewart to a point offshore common to both ports. For this analysis the common point is taken to be the pilot boarding station at Triple Island. These added marine costs will then be compared to the added land transport costs to Prince Rupert.

6.1 Terminal Costs at Stewart

In 1978, at the request of the B.C. Harbours Board, Swan Wooster Engineering Co. Ltd. prepared a Master Plan Study for the port of Stewart. The Report divides the port of Stewart into 7 zones (see Figure 4.1) and assigns the following development potential to each zone.

Type of Facility	Development Zone
Concentrate Export Terminal	1
Forest Products Terminal	5
General Cargo and Ro/Ro	3 & 5
Coal Export Terminal	7
Ferry Terminal	3
Marina Facilities	2



SCALE	DRAWN	YR	MO	DAY
AS SHOWN	T.B	78	4	17

B.C. HARBOURS BOARD

STEWART, B.C.
MASTER PLAN STUDY
DEVELOPMENT ZONES

SWAN WOOSTER ENGINEERING CO. LTD.

A4-3566

FIG. 4.1

6.1.1 Coal Terminal

For the purposes of this report, Zone 7 has been selected for location of a coal terminal and Zone 1 for a concentrate terminal. The following extracts from the Swan Wooster report give an indication of the main features of Zone 7.

Zone 7

> "Zone 7 incorporates the Marmot Bay and Lion Point area on the east shore of the Portland Canal. This is a flat area of about 60 hectares located 4 km south of the Bear River delta.
>
> One potential use in the long term for part of the Marmot Bay area is for a bulk coal export terminal for the Groundhog coal. The site could be reached by either railway or slurry pipeline from the coal fields. Locating the coal handling in Zone 7 allows the higher potential lumber terminal operations to be located in Zone 5 without the hazard of contamination.
>
> If a railway for a coal terminal in Zone 7 is ever developed, a branch rail line to Zone 5 could parallel the road access routes.
>
> Access to the Marmot basin area, although difficult, would not be prohibitive if the scale of development warranted a rail, pipeline or a road link. The mountain slopes along the shoreline average between 20 to 25 degrees which compares favourably with those along the Squamish Highway. Avalanche sheds would have to be built in 2 or 3 locations and snow clearing would be a normal winter activity."

Preliminary capital and operating cost estimates for both a 2.5 million tonne and a 5 million tonne coal terminal have been prepared. The capital cost estimates are based on the following factors:-

- An access corridor of 5 km (approx.) will be required from Stewart to the terminal. This has been estimated to cost $1 million per km.
- Site preparation costs are assumed to be slightly higher than at Ridley Island and are assumed to be $500,000 per acre for Stewart.
- A 5 million tonne per year terminal is assumed to require 20 ha; and a 2.5 million tonne per year terminal 15 ha.

- Dumping costs for the 5 million tonne per year terminal have been prepared on the assumption of rail dumping using a mechanical rotary dumper. Dumping costs for the 2.5 million tonne per year terminal are based on a truck dumping operation, using tipping trucks.

- For the 5 million tonne per year terminal two stacker-reclaimers are considered, and only one for the smaller terminal.

- The conveyor system is from dumper/storage area, to shiploader.

- The shiploader will be a dual quadrant type for 5 million tonnes per year terminal and a single quadrant for 2.5 million tonnes per year terminal.

- Site services include water supply, electric power, sewers and ancillary services.

- Site acquisition costs are not included.

- For the purposes of the following sections it will be assumed that the delta of the Marmot River is stable enough.

The capital cost estimates are shown in Table 6.1.

Table 6.1

Capital Costs (1982 $)
Potential Stewart Coal Terminal

	Terminal Throughput	
	2.5 Million tonnes/yr $ Million	5 Million tonnes/yr $Million
1. Transport Access Corridor	$ 5	$ 5
2. Site Preparation	19	25
3. Coal Dumper	6	12
4. Stacker/Reclaimer	5	10
5. Conveyor System	8	10
6. Wharf/Shiploader	28	36
7. Site Services & Utilities	4	5
Sub-total	75	103
& Engineering and Contingencies	18	25
(25%) (rounded)	$ 93	$128

The operating costs are summarized in the following Table 6.2.

Table 6.2
Estimated Operating & Maintenance Costs of Stewart Coal Terminal
(1982 $)

	Terminal throughput 2.5 MTPY	5.0 MTPY
	$ Million	$ Million
1. Manning	1.6	1.8
2. Civil & structural maintenance	0.4	0.4
3. Mechanical/electrical maintenance	1.7	2.5
4. Insurance/overhead/administration	0.5	0.6
5. Property Taxes	1.9	2.6
TOTAL and maintenance)	$6.1	$7.9

These costs are based on the following factors:-

- Manning:

  assumes:
  - 45 persons for 5 million tonnes per year terminal
  - 40 persons for 2.5 million tonnes per year terminal
  - $40,000 ($1982) per year, per person, wages and benefits.

- Civil and Structural Costs:

  $35 million for 2.5 million tonne terminal
  $44 million for 5.0 million tonne terminal
  Assume 1% of above for annual maintenance costs: percentage adopted from Vancouver Island Coal Port Study. (H.A. Simons)

- Mechanical/Electrical Costs:

  $58 million for 2.5 million tonne terminal
  $84 million for 5.0 million tonne terminal
  Assume 3% of above for annual maintenance costs: percentage adopted from Vancouver Island Coal Port Study (H.A. Simons)

- Based on approximatation for Ridley Island coal terminal costs: assume 0.5% per annum of total capital costs.

- Based on approximation for Ridley Island coal terminal costs: assume 2% of total capital costs.

- N.B. The following costs have not been included in above:
  a) Land acquisition, or land-lease
  b) Profit
  c) Income Taxes
  d) Spare parts inventory

Present Value and Unit Costs

Assuming a three year construction period, with annual capital costs evenly distributed, construction beginning 1987 and operations in 1996, the 1982 present value of the capital cost (using a 10% discount rate) is estimated to be $72 million for a 5 million tonnes/year terminal, and the present value of the operating costs to be $35 million.

The above capital (except for the 25% contingency) and operating cost estimates were inserted into a computer simulation model which estimated terminal throughput charges for coal shipments of 2.5 and 5.0 million tonnes per year. The rates derived were $9.06 for 2.5 million tonnes/year and $6.72 for 5.0 million tonnes/year. These rates which include a real after tax rate of return of 10% have been incorporated in the subsequent analysis.

6.1.2 Concentrate Terminal

In the Swan Wooster Engineering Ltd. Master Plan report, Zone I was selected as a site for a concentrate terminal. The following extracts from the Swan Wooster report give an indication of the main characteristics of Zone I:

> Zone I:
>
> Zone I incorporates the Granduc Terminal, the Premier Wharf and all of the Salmon River estuary north of the Canada-U.S. border. Access to the area is by way of the Stewart-Hyder road along the west shoreline of the Portland Canal. There is very limited land available in this zone since the side walls of the Canal are very steep at this location. The Shell oil storage tanks, on the west side of the road presently occupy most of this land.
>
> Proposed Development
>
> It is proposed that the Granduc wharf be used in the future as the bulk concentrate export terminal for the Port of Stewart. This should not present problems

with berth occupancy since even in the peak years of Granduc's production of 136,480 short wet tons the terminal was substantially under-utilized. Using the existing shiploader the terminal should be capable of exporting well over 500,000 tonnes of concentrate annually. To accommodate and maintain separately the additional throughput, more storage capacity for concentrate would be required on shore. This storage could probably be provided in new sheds placed on land reclaimed on either side of the terminal area. Land expansion to the north towards the Premier wharf may be limited by soil stability problems while expansion to the south may be limited by adverse environmental impacts.

Since the Swan Wooster report was prepared, the Granduc mine was closed but has recently been re-opened by Canada Wide Mines Ltd., a subsidiary of Esso Resources Ltd. The terminal is owned and operated by Canada Wide Mines Ltd. The terminal can accommodate vessels of up to 50,000 DWT.

The dock has covered storage for approximately 20,000 tonnes of copper concentrate, and vessels can be loaded at the rate of 360 tonnes (400 short tons) per hour.

Current exports are approximately 25,000 tonnes per annum. With its existing storage and loading capacity, the present terminal is capable of a throughput of approximately 200,000 tonnes (based on the assumption that for every ton of storage space available, a ten tonne throughput could be achieved).

It is assumed that the terminal would be receiving over 500,000 tonnes of concentrates per annum in the future. The main facility constraint to putting through this amount would be insufficient storage capacity; as the present shiploader could load at the rate of 360 tonnes per hour.

The estimated capital cost of the existing facility was $16 million. It is assumed that additional storage of up to 30,000 tonnes would be required, and the capital costs of the additional facility are shown in Table 6.3.

TABLE 6.3

CAPITAL STORAGE FOR 30,000 TONNE STORAGE FACILITY
(1982 million $)

Land fill/site prepartion	2.0
Concentrate Shed (Assume $400 for each tonne of storage = 400 x 30,000)	12.0
Engineering/Construction/Contingencies	2.0
	16.0

The operating and maintenance costs for the entire concentrate terminal are estimated in Table 6.4.

TABLE 6.4

OPERATING AND MAINTENANCE COSTS
(1982 $ Millions)

Manning (30 workers at 40,000/annum)	1.2
Maintenance (2% of capital)	0.3
Insurance (1% of capital)	0.2
Property Taxes (4% of capital)	0.7
	2.4

Present Value

Assuming a two year construction period would be required, beginning 1985, the present value of the capital costs at a 10% discount rate would be $12.6 million in 1982 dollars. The present value of the operating costs is estimated to be $12.7 million.

6.2 Terminal Costs at Prince Rupert

6.2.1 Coal Terminal

The Ridley Island coal terminal is being constructed to have a first phase design throughput capacity of 12 million tonnes[1]. The operating agent for the terminal, Federal Marine Terminals Inc. currently has a contract to handle 6.7 million tonnes per year beginning in 1984. Therefore there will be an annual surplus capacity of 5.3 million tonnes which could be handled at the terminal without any additional capital.

Assuming that Mt. Klappan is the first major new coal property to begin development and export coal from Western Canada there would be capacity available at Ridley Island. Thus it is reasonable to assume that no additional capital need be expended.

For additional tonnage (up to the terminal capacity) the rate will likely be that which will be charged the existing shippers under negotiated price formulas. The formula used for coal being shipped in 1990 yields a throughput charge of about $4.00 per tonne in 1982 dollars.

6.2.2 Concentrate Terminal, Prince Rupert

It is assumed that the terminal costs for concentrates at Prince Rupert would be similar to those at Stewart, i.e. approximately $15.00 per tonne.

6.3 Shipping Costs from Stewart and Prince Rupert

There are two factors which impact upon the cost of shipping coal or concentrates from Stewart rather than Prince Rupert. One is port limitations and the other is the added distance up the Portland Canal.

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1) Although design capacity is 12 million tonnes throughput may be more as in the case of Roberts Bank which was designed for 10 million tonnes and put through 12-13 million tonnes.

Port limitations refer primarily to the size of ship which can easily be accommodated in the port. For larger ships the per unit transport cost is lower because of the economies of scale that can be achieved.

For instance, various studies indicate the cost of transporting coal in 120,000 dwt ships from Vancouver to Japan is about $10.-12.00/tonne. This cost increases to around $15.-17.00/tonne if a 60,000 dwt ship is used. Assuming the coal terminal at Stewart had a size limitation of 60,000 dwt there would be about a $5.00 premium on coal shipped to the Japanese/Korean market.

In the case of concentrates, ship size does not seem critical since concentrate carriers tend to be in the 35-60,000 dwt range and port limitations are not therefore a factor.

The second factor which will increase shipping costs from Stewart is the added distance vis a vis Prince Rupert. The incremental distance to Stewart from the assumed common point of Triple Island is approximately 100 nautical miles. The approximate speed of a 60,000 dwt ship in that channel would be about 10 knots. Thus the added return time would be approximately 20 hours. To allow for any delays one extra steaming day would provide a realistic estimate of added time. This would allow for any loading delays.

The daily cost of a 60,000 dwt ship has been estimated to be around $28,436 (US) assuming an operating year of 345 days. Table 6.5 shows how the above cost was estimated.

TABLE 6.5
Annual Costs of a 60,000 DWT Bulk Carrier
1982 U.S. $000's

Capital Costs	$1,930.0
Manning	782.7
Fuel	3,962.0
Insurance, Commission, etc.	3,136.0
TOTAL	$9,810.7

* Source: An Analysis of a Potential Canadian Merchant Marine: Coal Traffic in the Pacific Market. B. Parrott, 1981.

Thus to go to Stewart the extra cost on a per tonne basis assuming a 60,000 dwt would be in the order of $.60 (CDN).

Given the other cost components in the transportation of concentrates and coal to market this is not a significant premium.

7.0 SUMMARY AND CONCLUSIONS

The objective of this study is to identify the least cost alternatives to transport coal, copper, asbestos and other minerals from potential mines in Northwest British Columbia to tidewater in the period 1982-2000.

Capital costs for upgrading the existing road and rail systems and constructing new road and rail alternatives were estimated on a preliminary basis. Operating and maintenance costs for both trucking and unit and non unit train operations were also estimated for each alternative transportation route.

There are at least two perspectives on what constitutes "least cost transportation", namely: (1) least cost to the economy as a whole and (2) least cost to the shipper of the commodity. The former perspective involves an accounting of all public and private, capital and operating transportation costs; the latter costs to the shipper of the commodity.

Section 7.1 summarises the findings in respect to perspective one; Section 7.2 summarises the findings in respect to perspective two. The case numbers in the following tables refer to the principal transportation alternatives which are:

Case 1: Base Case

i) Minerals from Kutcho, Letain, Red Chris, Schaft Creek, Eaglehead, Sustut and Stikine would be hauled by road, to either the port of Stewart or the port of Prince Rupert for export, whichever is the least cost haul.

ii) Minerals from Adanac would be taken by road or road rail to Skagway, for export. As their transportation would not impact on the Highway 37 corridor, transportation cost estimates were not developed.

iii) Coal from Klappan would be hauled by rail to the port of Prince Rupert for export, by the least cost existing or new rail route. An access road would also be required for employee transportation.

Case 2: BCR Extension from Klappan to Dease Lake

This case considers an extension of the BCR from Klappan to Dease Lake, a distance of 190 km (118 miles). Klappan coal would continue to be transported over the BCR and CNR to Prince Rupert via the least coal rail route (i.e. Hazelton Connector linking Suskeena on the BCR to Hazelton on the CNR). However, this extension would also provide a rail option for the transportation of minerals from five potential mines in the region (Kutcho, Letain, Eaglehead, Red Chris and Sustut) to Prince Rupert.

Case 3: Construction of a Rail Route from Dease Lake to Stewart

This case considers the construction of a new rail route from Dease Lake and Klappan to Stewart via Meziadin. This would provide an alternative to the road options of Case 1 and the previously described rail alternatives.

Relative to the previous case, this railway would reduce the haul distance for Klappan coal to tidewater and provide a rail option for the transportation of minerals from five potential mines in the region to Stewart.

Case 4: Construction of a Coal Slurry Pipeline from Klappan to Stewart

This case considers the construction of a coal slurry pipeline from Klappan coal via the route for the railway considered in Case 5 (ie. Klappan, Jackson Flats, Slowmaldo Creek, Damdochax Creek, Nass River, and over Bear Pass). It is assumed that minerals would be hauled by road to either Stewart or Prince Rupert, as per Case 1 the base case.

As an addendum, the transportation of one million tonnes of coal per year, by road, between Klappan and Stewart, was also investigated.

7.1 Total Public and Private Transportation Costs

The approach taken to estimate total public and private costs does not involve a full benefit-cost approach since this is

intended to be only a "pre-feasibility analysis" of transportation options in Northwest B.C. Some of the broader, environmental and social benefits and costs involved in constructing transportation corridors through Northwest B.C. are being investigated by other members of the Inter-Ministry Task Force on NWBC.

Table 7.1 presents a summary of the public and private sector capital costs in 1982 dollars associated with each transport alternative. Public road upgrading costs for the longer road haul to Prince Rupert were estimated to be $20 million higher than to Stewart. These higher capital costs and higher operating costs to Prince Rupert combined to rule out Prince Rupert as a cost effective option.

TABLE 7.1

Comparison of Transportation Cases
Estimated Capital Costs
(1982 $millions)

Item	Case 1	Case 2	Case 3	Case 4
Road (to Stewart)				
- Public	180	115	115	180
- Private	270	250	250	270
Railways				
New Construction & Upgrading				
- via Prince George	280	380	N/A	N/A
- via Vanderhoof	290	390	N/A	N/A
- via Hazelton	365	465	N/A	N/A
- via Meziadin	500	600	N/A	N/A
- to Stewart	N/A	N/A	470	N/A
Slurry Pipeline				
- to Stewart	N/A	N/A	N/A	360
Port Terminals				
- Stewart Concentrate:	16	8	16	16
- Stewart Coal:	N/A	N/A	130	130
- Prince Rupert Concentrate:	N/A	8	N/A	N/A
- Prince Rupert Coal:	0	0	N/A	N/A

Table 7.2 presents both the capital and operating costs of each case in present value terms. The discounted capital costs are based on the actual costs shown in Table 7.1 and are discounted according to the proposed mine start dates per the development scenario.

The railway costs shown are those associated with the Hazelton connector, since that rail alternative was estimated to be the least cost rail route when operating and rolling stock costs were also taken into account.

Tentative conclusions indicate:

- None of the cases investigated shows a definitive cost advantage over another. The present value cost of constructing and/or upgrading road and rail infrastructure in northwest B.C. and providing transportation services to the potential mines is estimated to be about $730 million in present value terms.
- Given the dispersed geographical distribution of the potential mines and the differing transportation requirements of coal, copper and zinc concentrates, asbestos and other minerals from these mines, no single mode of transportation nor one corridor for transportation services would meet all mines' requirements. A multi-mode, multi-route transportation system would be required to serve the potential resource centres in Northwest B.C.

TABLE 7.2

Comparison of Transportation Cases
(Present Value 1982 $Millions - 10% discount rate)

Item	Cost			
	Case 1 ($M)	Case 2 ($M)	Case 3 ($M)	Case 4 ($M)
Road				
• Construction & Maintenance				
- Public Highways	151	98	98	151
- Private Roads	71	77	79	71
• Transportation of Minerals	69	53	54	69
Rail				
• Railway Construction & Maintenance	227	292	290	N/A
• Rolling Stock	14	16	10	N/A
• Coal Transportation	164	164	80	N/A
• Other Minerals Transportation	NIL	12	6	N/A
Slurry Pipeline				
• Construction	N/A	N/A	N/A	223
• Operation	N/A	N/A	N/A	92
Port Terminals				
• Coal Terminal				
- Capital	-	-	72	72
- Operating[1]	20	20	35	35
• Other Minerals Terminal				
- Capital	13	13	13	13
- Operating	13	13	13	13
Total	752	758	750	739

Notes:

1) Assumes the actual operating cost at Ridley Island port is $1.00/tonne. (This would not include any sunk capital costs.)

- N/A - Not Applicable
- The least cost transportation option in each case is used.

7.1.1 Transportation of Copper Concentrates/Other Minerals Except Coal

Table 7.3 summarizes the present value costs for each case when costs associated with coal traffic are not included in the comparison. It can be noted from the table that Case 1 (road transportation to Stewart) would appear to be the least costly alternative for shipping concentrates and asbestos.

TABLE 7.3

Comparison of Transportation Costs (Excluding Coal Traffic)
(1982 Present Values, $Millions)

Item	Case 1	Case 2	Case 3
Road			
Construction and Maintenance			
- Public Highways	151	98	98
- Private Roads	59	53	55
Transportation of Minerals	69	53	54
Rail			
Construction and Maintenance	N/A	65	65
Rolling Stock	N/A	2	3
Transportation of Minerals	N/A	12	6
TOTAL	279	283	281

The cost estimates in both Tables 7.2 and 7.3 assume that all mines in the scenario actually come into production as hypothesized. Should this not be the case, system transportation capital and operating costs would change. Most notably, if Sustut did not come into production Case 1 costs would decrease by $19 million to $260 million; Case 2 costs would decrease by $4 million to $279 million and Case 3 costs would decrease by $9 million to $266 million but the case rankings would not change.

7.1.2 Coal Transportation

The analysis indicates that, at a coal production level of five million tonnes per year, the least cost transportation alternative may be a railway from Klappan to Stewart (i.e. Case 3). The respective case costs are shown in Table 7.4. Again, these costs must be regarded as preliminary and subject to change as engineering data on the feasibility and cost of constructing railways in the region become available.

Table 7.3 also shows that the construction and operation of a coal slurry pipeline (Case 4) between Klappan and Stewart would appear to have a slight cost advantage over rail transportation to Prince Rupert either via the BCR Dease Lake Extension (Case 1) or via a new Hazelton connector (Case 2).

TABLE 7.4

Comparison of Transportation Costs for Coal Shipments
(1982 Present Value $Millions)

Item	Case 1	Case 2	Case 3	Case 4
Road				
Construction and Maintenance*	24	24	24	24
Rail				
Rail Construction and Maintenance	227	227	225	-
Rolling Stock	14	14	7	-
Transportation of Coal	164	164	80	-
Slurry Pipeline				
- Construction	-	-	-	223
- Operating	-	-	-	92
Port				
Coal Terminal				
- Construction	-	-	72	72
- Operating	20	20	35	35
TOTAL(Rounded)	450	450	410	450

* Assumes no road cost sharing with Sustut

However recent discussion with Gulf Canada Resources have indicated it's preference for using rail transportation rather than pipeline for the following reasons:

(i) Engineering/technical constraints:-
- Anthracite coal markets require the product to remain in large lumps whereas the transportation of coal in a slurry pipeline requires the coal to be ground into small particles.
- Pipeline capacities are largely fixed (i.e. by pipe diameter, etc.) and allow little flexibility once the facility is in place whereas railways offer more flexibility with respect to throughput because cars can be added to trains and more trains operated.

(ii) Environmental constraints (eg. waste water may be problematic).

(iii) Costs considerations (the company's own preliminary analysis does not indicate a definitive cost advantage for slurry pipeline vis a vis other modes).

For these reasons it is unlikely that a slurry system will be considered further.

For a production level of between 1 and 2 million tonnes per year it may be feasible to truck coal to Stewart. A brief analysis was carried out to estimate the relevant trucking costs. This preliminary assessment indicated that the 1982 present value of haul costs would be about $80 million via the Nass River to Stewart based on a haul distance of about 262 kilometers.

7.1.3 Limited Production Scenario

Table 7.5 presents an example of the costs in a limited production scenario in which the only mines in production would be Klappan coal, Kutcho Creek, Schaft Creek and Stikine.

Although no case shows a definitive cost advantage when coal traffic flows on the transportation systems, when coal traffic is ignored, the analysis indicates that traffic from Kutcho Creek, Schaft Creek and Stikine mines would likely be hauled by road to Stewart, for export.

TABLE 7.5

Comparison of Transportation Costs
(Limited Production Scenarios)
(1982 Present Value $Millions)

Item	Case 1	Case 2	Case 3	Case 4
Road				
Road Construction and Maintenance				
- Public Highways	133(1)	80(3)	80	133
- Private Roads	72(2)	72	72	72
Transportation	57(2)	48(4)	48	57
Rail				
Rail Construction and Maintenance	227	292	290	-
Rolling Stock	14	15	9	-
Transportation of:				
- Coal	164	164	80	-
- Concentrates/Other Minerals	-	6	3	-
Slurry Pipeline				
Construction	-	-	-	223
Operating	-	-	-	92
Port				
Coal Terminal				
- Capital	-	-	72	72
- Operating	20	20	35	35
Concentrate Terminal				
- Capital	13	13	13	13
- Operating	13	13	13	13
TOTAL	713	723	715	710
Total Without Coal	264	274	272	264

NOTES:

1) Costs for link 8 (PV $8.5 million in 1982) are now assumed to be private sector costs, not public sector costs. Costs for paving links 11 and 13 (PV $9.4 million in 1982) are eliminated.

2) Costs for Kutcho Creek, Stikine, Schaft Creek and Klappan employee access

3) Links 19, 20 and 21 only.

4) Same assumptions for Kutcho Creek as in Table 5.1.

7.2 Commodity Rates/Costs to Shipper

The future commodity rates offered by the railways and road haulers, between the mines in Northwest B.C. and tidewater, will be important determinants of the economic feasibility of the potential mines, the modes of transportation selected and the routes used between mines and tidewater.

This pre-feasibility analysis has concentrated upon the development of costs for road and rail infrastructure and services, rather than upon the development of commodity rates. However, if it is assumed that the unit costs developed for transportation of commodites in this analysis can be used as surrogates for commodity rates some comparisons of alternatives facing the shipper can be made. This assumption may not be unrealistic. In the case of rail, for example, the commodity rate would be based to a great degree on the amount of operating, rolling stock and rail construction costs as well as on market factors. The correlation between rates and costs would be less in the case of road transportation since only a portion of the cost of constructing public highways is recovered through truck licence fees.

Given the above limiations of the approach, the following analysis compares the alternative cases from the perspective of the shipper of the commodity.

7.2.1 Copper Concentrates/Other Minerals Except Coal

Table 7.6 below compares unit costs for the shipment of products from seven of the mines in Northwest B.C. to tidewater.

TABLE 7.6

Unit Transportation Costs; Mines to Tidewater
(1982 $/tonne)

Mine	Case 1	Case 2	Case 3
Kutcho Creek	29.30	58.10	51.50
Letain	26.90	50.60	45.30
Eaglehead	26.50	51.10	45.70
Red Chris	18.30	34.30	29.30
Schaft Creek	16.80	*	*
Sustut	20.40	14.20	17.42
Stikine	26.90	*	*

* - Same as Case 1.

As noted above, the unit costs do not include private or public road access costs since these would not be the responsibility of the trucking company; and these costs would not be covered by truck license fees. On the other hand, rail construction costs are included in the rail unit costs for Cases 2 and 3. Combined road-rail costs were not prepared for Stikine and Schaft Creek since the road-rail options in these cases would involve considerable, extra haul distances to tidewater or unnecessary inter-modal transfers.

The table shows that the least costly case would be Case 1 which suggests that road transport to Stewart would be the least cost option for each mine except Sustut. Because of Sustut's location, rail transport to Prince Rupert would be the least cost option for Sustut. As noted in Section 6, it is assumed that terminal costs at the Port of Stewart would be similar to those at Prince Rupert (i.e. about $15/tonne) and that the extra cost to ship from Stewart would be an insignificant $0.60/tonne.

7.2.2 Coal Transportation

The cost comparisons shown in Table 7.4 indicated that a rail route to Stewart (i.e. Case 3) would be the least cost option to transport coal from Klappan to tidewater. The unit cost of this case would be about $14/tonne. By comparison, the unit costs in Cases 1 and 4 would be $18.30 and $14.50 respectively.

The analyses in Section 6 indicated that terminal rates at the Ridley Island port would be about $4/tonne and at Stewart about $10/tonne for a new terminal. However, taking into account the additional haul distance to Prince Rupert no definitive cost advantage could be identified for transporting coal via Stewart or Prince Rupert.

Unit costs for trucking 1 million tonnes of coal to Stewart were estimated to be between $21 and $26/tonne in 1982 dollars.

As noted previously, detailed engineering feasibility and cost studies are required to further evaluate the above, tentative conclusions.

7.3 Principal Conclusions

While it must be stressed that the analysis is a pre-feasibility analysis based on mine production scenario #1, three principal conclusions were reached, as follows:

1. From two perspectives (i.e. total public and private cost; mine-shipper cost), the preferred (least cost) option for the transportation of concentrates and asbestos would be via road to Stewart, for export. This would involve upgrading Highway 37 as well as constructing new mine access roads.

2) From the same two perspectives, the preferred option for the transportation of coal would be by rail. A new rail route to Stewart would appear to be the least cost option but the analysis on this route was conducted without the benefit of any engineering feasibility studies. Further, construction of a coal terminal at Stewart may prove technically difficult and costly. The next, least cost rail route, a connection to Hazelton, may in fact be the preferred option at a mine production of five million tonnes per year. This would involve upgrading part of the BCR Dease Lake Extension between Klappan and Suskeena and the construction of a new rail route between Suskeena and Hazelton on the CNR Northline.

3. Even under the most optimistic assumptions regarding potential mine outputs and backhaul traffic to the mines, an extension of the railway from Klappan to Dease Lake does not appear to be economically feasible.

APPENDIX 1

Transportation of Coal by Truck

A possible production scenario recently discussed by Gulf Canada Resources would be to mine one to two million tonnes of high quality, anthracite coal per year for sale in premium price, overseas markets. At such a level of production, road haulage of coal might prove more economical than alternative transportation systems (rail or pipeline). If coal was hauled by road it is assumed concentrates and other minerals would also be transported by road as discussed in Case 1 in Chapter 4.

Network

The purpose of the analysis in this section is to estimate costs for trucking one million tonnes of coal annually from Klappan to either Stewart and Prince Rupert. Two possible road routes from Klappan to Highway 37 have been considered, both involving the construction of new roads. One route would be along the Nass River Valley to connect with Highway 37 near Meziadin; the other would be a longer route, northwards up the BCR grade to McEwan Creek then westwards along an existing trail to connect to Highway 37 at Eddontenajon Lake. The distance to Stewart over the first route would be about 262 km, and over the northern, more circuitous route, about 480 km.

Road Construction Costs

Using the unit costs developed for mine access roads in Section 4 the capital cost for the access road from Meziadin to Klappan via the Nass Valley is estimated to be about $39 million; with maintenance costs about $0.7 million per year. Assuming road construction costs over the BCR subgrade would be 50% of new construction costs and that 60 km of trail would require re-construction, the capital cost for the more circuitous route via McEwan Creek and Eddontenajon is estimated to be about $22 million; with maintenance costs about $0.6 million per year. The 1982 present value of these costs is shown in Table A-1.

TABLE A-1

Present Value of the costs of Trucking Coal to Stewart (Using 10% Discount Rate)

Cost	Via Nass Valley ($ million 1982)	Via McEwan ($ million 1982)
Haul	76	114
Road Construction	23	13
Road Maintenance	3	2
Total	102	129
Present Value of mine output (million tonnes)	4.9	4.9
Road Transport - cost/tonne	$20.80	$26.30

Road Haul Costs

Based on distances and the hourly operating costs described in Section 4.1.5, the haul cost via the Nass Valley route is estimated to be $17.50/tonne; and via McEwan Creek to be $25.90/tonne. When road construction, road maintenance and haul costs are combined and expressed in net present values the cost/tonne via the Nass Valley route would be $20.80; and via McEwan Creek $26.30.

If the destination was Prince Rupert, rather than Stewart, the distance added to the truck haul would be 420 km and the addition to haul costs would be $18/tonne.

Although charges for shipping one million tonnes of coal per year through the Port of Stewart are not known, it is not expected that the charge will exceed the combination of the additional road haul cost to Prince Rupert and the coal terminal through-put charges at the Prince Rupert port (ie. respectively $18/tonne plus $4/tonne for a total of $22/tonne).

By comparison, the preliminary analysis of transporting one million tonnes of coal by rail, from Klappan to Prince Rupert, using the least cost route via a Vanderhoof connector, indicated that the cost per tonne would be in the order of $51.

In conclusion, if one million tonnes of coal per year were shipped from Klappan, the preferred port destination would be Stewart rather than Prince Rupert.